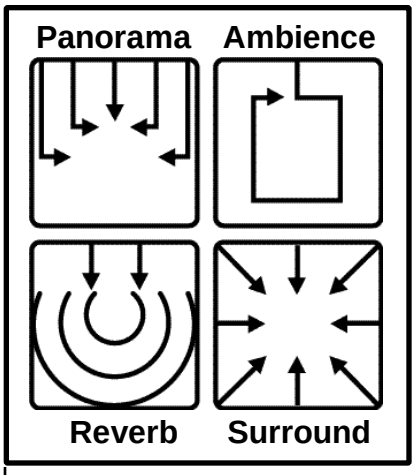

CP-1 Digital Audio Environment Processor

Owner's Manual

lexicon

A Harman International Company

Unpacking and Inspection

After unpacking the CP-1, save all packing materials in case you ever need to ship the unit. Thoroughly inspect the CP-1 and packing materials for signs of damage. Report any shipment damage to the carrier at once; report equipment malfunction to your dealer.

Precautions

This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device, in accordance with the specifications in Subpart J or Part 15 of FCC Rules, which are designated to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment OFF and ON, the user is encouraged to try to correct the interference by one or more of the following measures:

Reorient the receiving antenna
Relocate the computer with respect to the receiver
Move the computer away from the receiver
Plug the computer into a different outlet so that the computer and receiver are on different branch circuits

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio/TV Interference Problems"

The booklet is available from the U.S. Government Printing Office, Washington DC 20402, Stock No. 004-000-00345-4.

Acknowledgements

The CP-1 is manufactured under license from Dolby Laboratories Licensing Corporation. Additionally licensed under one or more of the following patents: U.S. numbers 3,632,886, 3,746,792 and 3,959,590; Canadian numbers 1,004,603 and 1,037,877. "Dolby" and the double-D symbol are trademarks of Dolby Laboratories Licensing Corporation.

06/00 | Lexicon Part No. 070-06619 | Rev 3.0

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Safety Suggestions

Read Instructions Read all safety and operating instructions before operating the unit.

Retain Instructions Keep the safety and operating instructions for future reference.

Heed Warnings Adhere to all warnings on the unit and in the operating instructions.

Follow Instructions Follow operating and use instructions.

Heat Keep the unit away from heat sources such as radiators, heat registers, stoves, etc., including amplifiers which produce heat.

Ventilation Make sure that the location or position of the unit does not interfere with its proper ventilation. For example, the unit should not be situated on a bed, sofa, rug, or similar surface that may block the ventilation openings; or, placed in a cabinet which impedes the flow of air through the ventilation openings.

Wall or Ceiling Mounting Do not mount the unit to a wall or ceiling except as recommended by the manufacturer.

Power Sources Connect the unit only to a power supply of the type described in the operating instructions, or as marked on the unit.

Grounding or Polarization* Take precautions not to defeat the grounding or polarization of the unit's power cord.

*Not applicable in Canada.

Power Cord Protection Route power supply cords so that they are not likely to be walked on or pinched by items placed on or against them, paying particular attention to cords at plugs, convenience receptacles, and the point at which they exit from the unit.

Nonuse Periods Unplug the power cord of the unit from the outlet when the unit is to be left unused for a long period of time.

Water and Moisture Do not use the unit near water — for example, near a sink, in a wet basement, near a swimming pool, near an open window, etc.

Object and liquid entry Do not allow objects to fall or liquids to be spilled into the enclosure through openings.

Cleaning The unit should be cleaned only as recommended by the manufacturer.

Servicing Do not attempt any service beyond that described in the operating instructions. Refer all other service needs to qualified service personnel.

Damage requiring service The unit should be serviced by qualified service personnel when:

the power supply cord or the plug has been damaged,

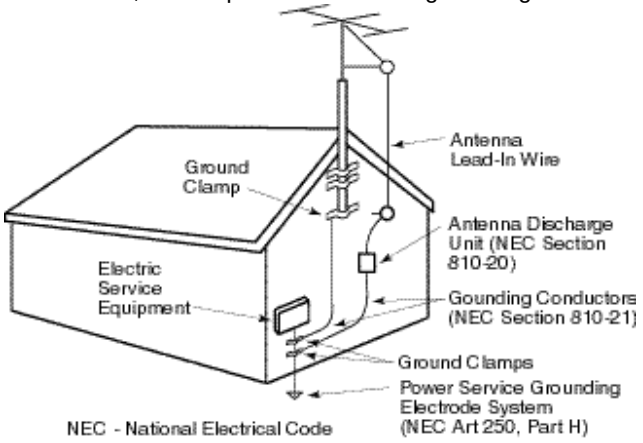
objects have fallen, or liquid has been spilled into the unit,

the unit has been exposed to rain,

the unit does not appear to operate normally or exhibits a marked change in performance,

the unit has been dropped, or the enclosure damaged.

Outdoor Antenna Grounding If an outside antenna is connected to the receiver, be sure the antenna system is grounded so as to provide some protection against voltage surges and built-up static charges. Section 810 of the National Electrical Code, ANSI/NFPA No. 70-1984, provides information with respect to proper grounding of the mast and supporting structure, grounding of the lead-in wire to an antenna-discharge unit, size of grounding conductors, location of antenna-discharge unit, connection to grounding electrodes, and requirements for the grounding electrode.



Power Lines An outside antenna should be located away from power lines.

Table of Contents

Controls and Indicators 1

Introduction

All of the programs in the Lexicon CP-1 Digital Audio Environment Processor have a common goal: to draw you, the listener, more deeply into a musical performance or a film. For music the CP-1 uses unique digital processing to re-create either the original recording space or a new one of your choosing. For films it offers an extremely accurate version of Dolby Pro Logic Surround decoding and our own decoding for monaural film soundtracks. The increase in impact of a musical performance or film when heard with the CP-1 is enormous, especially when widely spaced multiple loudspeakers are provided, but even without additional loudspeakers significant gains are made.

To re-create the experience of being at a performance the CP-1 draws on recent studies of concert-hall acoustics, and applies this research to home listening rooms. The object is to increase the sideways-moving sound in a room, thus increasing *Spatial Impression*, or SI.

The CP-1 increases SI by either *extracting* it from the original recording, using the Panorama or Surround programs, or by *generating* a new acoustic environment with Ambience or Reverb.

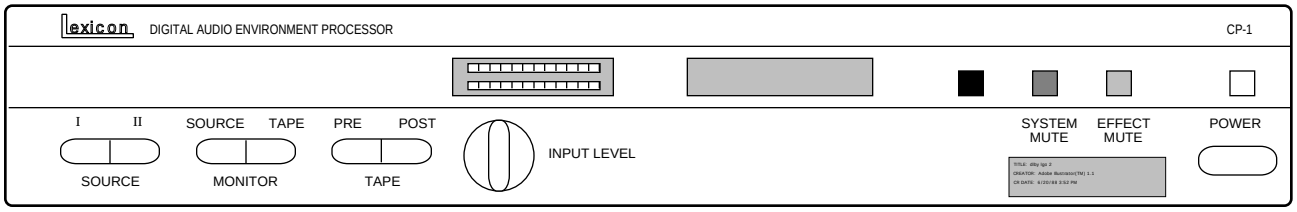
When a listener is in the correct spot the Panorama program provides an almost ideal re-creation of the original recording space. It works by using digital processing to cancel the crosstalk between the listener's ears, effectively spreading the sound from the two front loudspeakers in a wide arc in front of the listener. With the optional addition of rear speakers, Panorama can be almost spooky in its realism.

The CP-1 Reverb and Ambience programs provide signals for driving widely spaced side and rear loudspeakers, directly exciting sideways sound and heightening the listener impact over a large listening area. (When there are no side speakers, Panorama is used to increase the sideways sound from the main speakers.)

The Ambience and Reverberation programs transform the listening room into a new acoustic space, letting you choose an environment which matches your music or your mood. Unlike some previous hall simulators, the CP-1 provides full stereo processing. The Ambience program generates the side and rear reflection patterns of idealized rooms and concert halls. The larger spaces add the true depth and realism of a concert hall to classical and popular music, while the smaller spaces are ideal for jazz and rock. The Reverberation program is similar, but places more emphasis on rich, dense reverberant decay than on early reflections. It is especially good for simulating large, highly reverberant spaces.

For films encoded with Dolby Stereo, Lexicon has incorporated into the CP-1 the first completely digital Dolby Pro Logic Surround decoder, and the only one with automatic correction of azimuth and channel-balance errors (the most common problems in currently available films). The CP-1 also provides a program for playing music through a Surround speaker set-up (Stereo Logic), and a program for expanding monaural film sound tracks (Mono Logic).

The Front Panel



Source The SOURCE buttons select one of two identical stereo pairs of audio inputs. Ordinarily Input I will be connected to the main outputs of your stereo preamp and the second input will be a spare. In video installations, Input I will be connected to the main audio outputs of your TV receiver, VCR or audio / video control center. Input II can then accept the outputs of a separate system or the audio outputs of a video disc or CD player.

Monitor The MONITOR button selects SOURCE I / II or TAPE IN. The Tape inputs are provided to accommodate a recorder if the CP-1 occupies a previously used tape monitor loop.

Tape The PRE and POST Tape switch determines whether CP-1 processing if applied before or after tape output. PRE means that the tape deck gets the signal unaltered (PRE-processing); POST applies CP-1 processing to the tape output (POST-processing).To record CP-1 processing onto tape the CP-1 must be in the two-speaker mode (Configuration 1) with the POST button engaged.

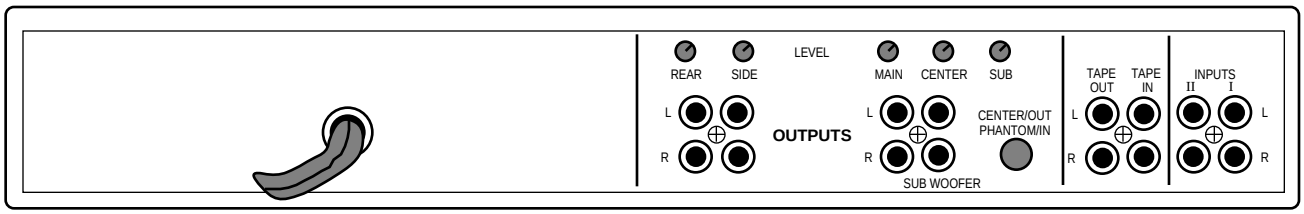
Input Level The INPUT LEVEL control and its display allow you to match the level of the incoming signal to the CP-1's digital encoding circuits. When correctly set, loud passages will light the entire row of green LEDs without flashing the red ones.

Alphanumeric Display The alphanumeric display shows both the program that is running and its modifiable parameters. The CP-1 has 24 registers: PRESETs 1-12 are configured at the factory; those labeled USER 1-12 are available for storage of programs customized by the user.

Indicator Lights The unlabeled LED to the left of the System Mute Indicator lights when the CP-1 detects a signal from the remote control. The SYSTEM MUTE LED indicates that unprocessed audio is no longer passing through to the CP-1's main outputs. The EFFECT MUTE LED indicates that the CP-1's processed audio is no longer passing through to its outputs.

Power System On / Off.

The Rear Panel



Rear and Side Outputs

Stereo outputs for rear and side power amplifiers, with level adjusting knobs. The procedure for balancing these outputs (as well as the center channel and subwoofer) with the main pair begins on page 9.

Main, Center and Subwoofer Outputs

Main outputs, with level adjustment. Level-setting of these outputs must precede adjustment of the auxiliary channels.

The adjustment of the subwoofer output should be done only after all other channels are calibrated. (See page 11.)

Center/Out Phantom/In

Center channel output with level control and button. Push the button in if you have no center channel; leave it out if a center speaker is connected. NOTE: Leaving this button out with no center channel will cause the Surround programs to malfunction.

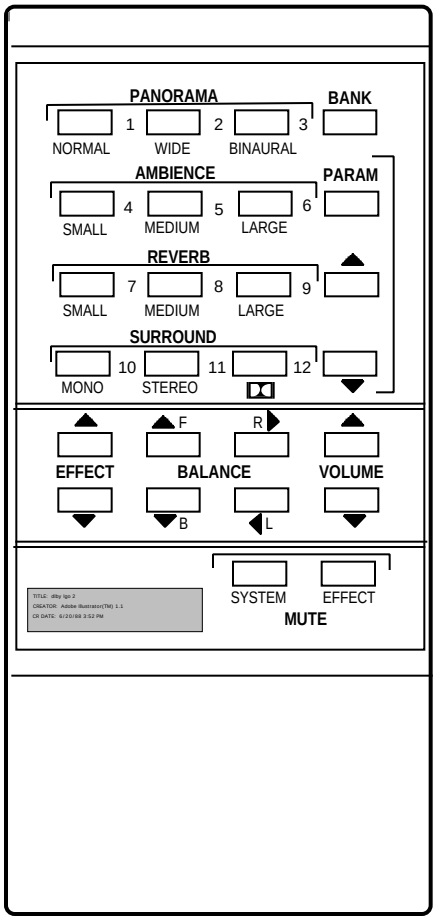
Tape Out/In

Inputs and outputs for an additional audio or video tape deck (audio portion only) or to replace the monitor loop occupied by the CP-1.

Inputs

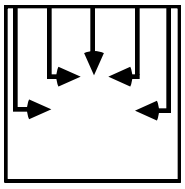
Two sets of main inputs, selected by the SOURCE I/II buttons.

The Remote Control



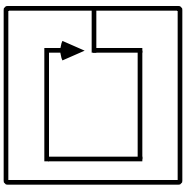
The Programs

Panorama



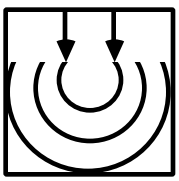
The PANORAMA programs provide enhanced lateral sound (and hence greater spaciousness and envelopment) for either music or films. This program can utilize left and right rear channels but is also effective using only the two front loudspeakers. NORMAL(1) and WIDE(2) differ primarily in their initial Effect Levels. BINAURAL(3) is for playback on loudspeakers of recordings made with a dummy head.

Ambience



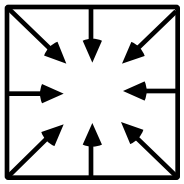
The AMBIENCE programs simulate concert halls of three different sizes, generating reflections of appropriate directionality, delay and spectral shape and sending them to the side and rear speakers. The Ambience programs provide adjustable recirculation through the Liveness parameter but for long reverberation times, use REVERB. Both AMBIENCE and REVERB are true stereo simulators.

Reverb



The REVERB programs, like AMBIENCE, simulate rooms of three sizes with the aid of side and rear channels. These programs have fewer specific initial reflections than AMBIENCE but richer and smoother reverberant decay. REVERB is especially good for simulating large, highly reverberant spaces.

Surround



The SURROUND programs work with film sound tracks to recreate the theater experience. MONOLOGIC (10) expands the music and effects on monaural films into the additional channels while leaving the dialog in the front center. STEREO LOGIC (11) enhances music with surround speakers and also allows the listener to adjust certain parameters for film sound that are fixed in Program 12. PRO LOGIC (12) provides the same decoding used in Dolby Stereo theater systems, using up to eight speakers for front, center, side, rear and subwoofer channels.

Bank

The BANK button switches between the 12 factory-preset programs and 12 user registers where customized programs may be stored. The program number doesn't change: if you are using Preset program 9, BANK switches to User program 9 and vice-versa. Holding BANK for a few seconds puts the CP-1 into Configuration mode, in which the three Parameter buttons adjust the LCD contrast and select one of the 12 speaker setups illustrated on page 13.

Parameter

The three PARAMETER buttons allow selection and adjustment of variable parameters within each program. Pushing PARAM displays the current parameter for five seconds; pushing it again before the display changes selects the next parameter. Pressing PARAM UP or DOWN will display and adjust the current parameter, whether or not PARAM has been pushed. A single push changes the parameter by one unit; holding the button for more than one second causes the values to change rapidly in an *auto-repeat* mode. PARAM can also put the CP-1 into TEST mode. (See page 19.)

Effect*

EFFECT: UP and DOWN adjust the level of all signals added by the CP-1.

Balance*

BALANCE: F and B adjust the levels of the rear speakers relative to the sides and fronts.

BALANCE: L and R adjust the left / right balance of all speakers: front, sides and rear. It assumes the function of the balance control on your preamp or receiver.

Volume*

VOLUME: UP and DOWN adjust the level of all channels simultaneously. It assumes the function of the volume control on your preamp or receiver.

Mute

SYSTEM MUTE turns off all outputs and lights both SYSTEM and EFFECT MUTE LEDs. Pushing EFFECT MUTE while in system- mute mode turns the effects alone back on.

EFFECT MUTE alternately turns off and on all signals added by the CP-1. Use it to compare the sound with and without CP-1 processing. **In TEST mode EFFECT MUTE clears all user memories. (See page 19.)**

*The first push of either of this pair of buttons displays the current value for five seconds; another push during that time increases or decreases the displayed value. Holding the button down for 1 second engages auto-repeat.

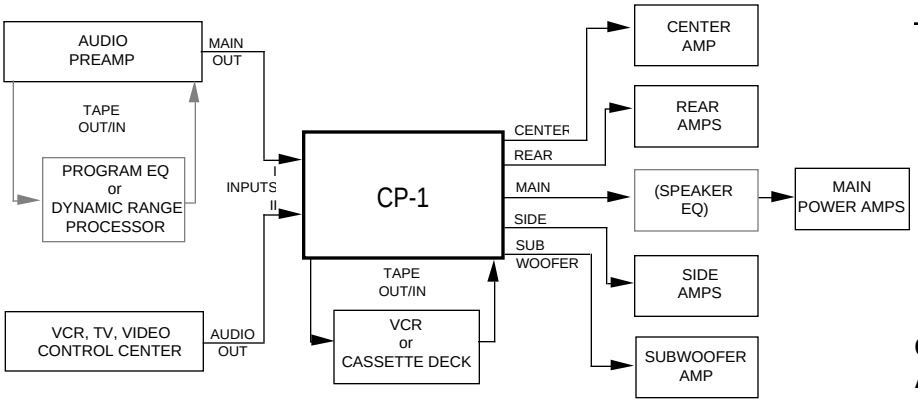
Installation

The CP-1 may be installed on a shelf or in a standard 19" equipment rack, using the optional rack-mounting hardware (Lexicon part #021-06639). Connect the power cord to a wall outlet or to a switched outlet on the back of your preamplifier. Observe the following precautions:

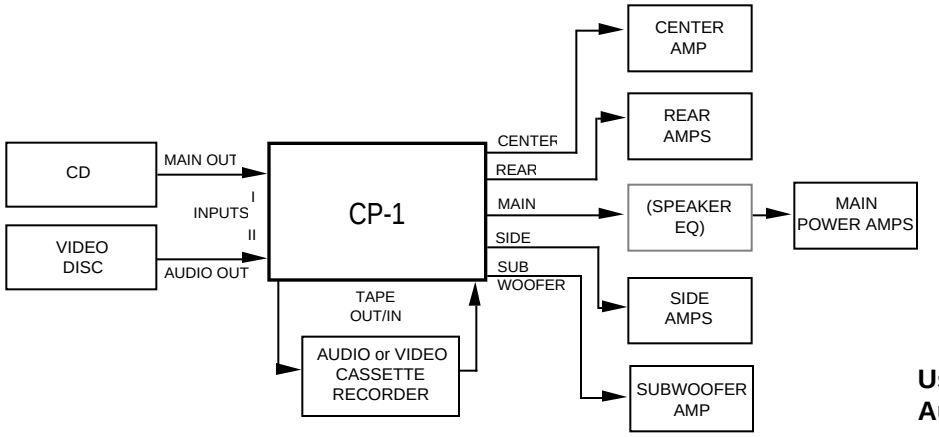
Precautions

- Make sure the remote control receiver, located on the right side of the front panel, is unobstructed. The remote control must be in line of sight to this receiver for proper operation. The CP-1 may be placed in a glass-doored cabinet but smoked glass will make the display hard to read.
- Select a dry, well-ventilated location out of direct sunlight.
- Do not stack the CP-1 directly above heat-producing equipment such as power amplifiers.
- Avoid placing the CP-1 near unshielded TV or FM antennas. The CP-1 may interfere with some FM tuners if it is placed immediately above or below them.
- Install two AAA batteries in the CP-1's remote control.

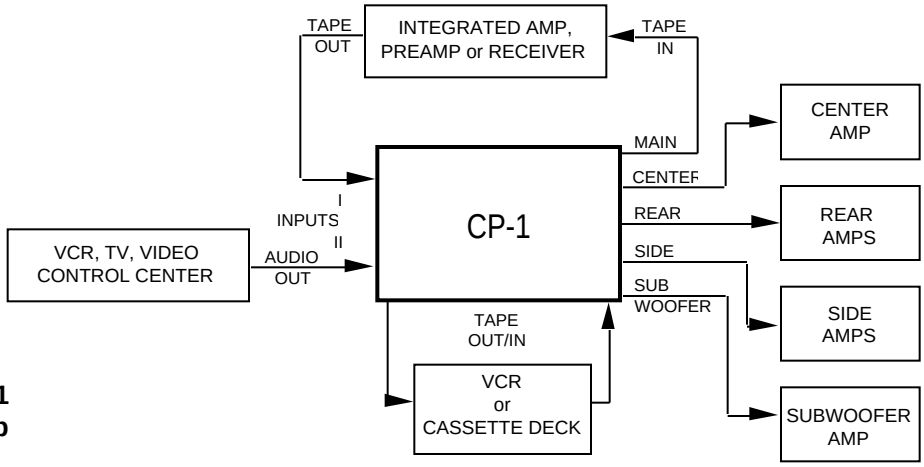
Connections to Other Equipment



Connections with an Audio Preamp



Using the CP-1 as an Audio Preamp



Connecting the CP-1 in a Tape Monitor Loop

Note If you have a receiver with no external access to the preamplifier outputs (or you wish to use the tape monitor loop on your preamp), you can use a tape output or external processor loop to the CP-1. However, any change in the receiver's volume control after the system is adjusted will upset the balance between the main and auxiliary speakers. If you are using this configuration, you should now turn the receiver's volume control all the way down. If there was a tape deck previously connected to your receiver's monitor loop, connect it to the CP-1's tape outputs and inputs.

Turn off ALL audio and video components, including individual power amplifiers. (Unplug any preamps and power amps that don't have switches.) Locate the gain trim potentiometers on the CP-1 rear panel; these are knobs at the top of the panel, marked REAR, SIDE, MAIN, CENTER and SUB. Turn each one all the way down (counterclockwise as viewed from the back).

Audio Inputs

Connect the main outputs of your audio preamplifier or the preamplifier output of your receiver to Input I on the CP-1.

Note Inputs I and II are electrically identical and can be used interchangeably. The CP-1 will also act as a line-level preamp with three inputs (including the built-in tape monitor loop) if you wish to connect, for example, the audio outputs from a TV receiver / monitor, a CD player and a VCR directly to it.

Audio Outputs

Connect the CP-1's MAIN outputs to your main stereo channels. Connect any additional amplifier / speaker combinations to the remaining outputs on the CP-1: SIDE to the side amplifiers, REAR to the rears, CENTER to the center- channel amplifier and SUB WOOFER to the subwoofer amp.

Locate the button below the SUB potentiometer marked CENTER / OUT, PHANTOM / IN. If you have no center front speaker, push it in; if you have a center channel, make sure this button is in the out position.

Push the INPUT I button on the front panel. Push the MONITOR SOURCE and TAPE PRE buttons. Turn the INPUT LEVEL knob all the way down (counterclockwise).

Front Panel Adjustments

Setting the Main Input and Output Levels

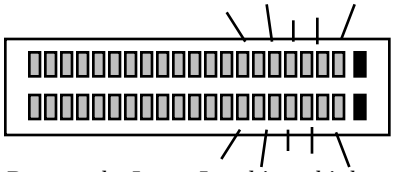
The CP-1 has its own volume and balance controls, which you will be using in place of the ones on your existing preamp or receiver. Set the gains in your main stereo channels for optimum dynamic range as follows.

For best performance, the CP-1 should always be driven to its full Input Level.

Turn on the CP-1. For the first two seconds the display should read: LEXICON CP-1, with a software version number and a copyright notice. For another two seconds there will be a configuration message, then a program name will appear. When the power-up routine is finished, aim the remote control at the unit and push the EFFECT MUTE button (bottom row, right). The message: EFFECTS OUTPUTS OFF will appear in the display for about 4 seconds and the EFFECT MUTE LED on the front panel will light.

Input Levels

Turn on your preamp, choose a signal source and play some loud music (a heavily compressed FM rock station or heavy-metal CD is ideal). Turn the preamp's volume control up about three quarters of the way. Adjust the CP-1's INPUT LEVEL control until the red level-indicator LEDs at the right of the display blink occasionally, then reduce the INPUT LEVEL until only the green LEDs are lit.



Be sure the Input Level is as high as possible without flashing red.

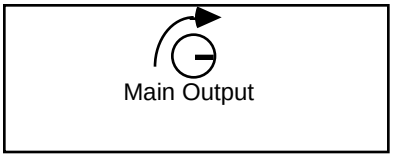
If there are audible differences between the levels of the source you used for this calibration procedure and other sources, you may have to readjust the INPUT LEVEL to accommodate them. Where possible, try to use the output level controls on the various sources to equalize levels.

Set all output levels to zero; set Volume UP almost all the way.

Push and hold the VOLUME DOWN button on the remote control until the bar graph on the display completely disappears and the display reads SYSTEM VOLUME -64 dB. Turn on the main stereo power amplifier, then hold the VOLUME UP button until the CP-1's volume is at -05 dB. If the back-panel potentiometers are turned all the way down, as they should be, you will not hear any sound yet. If you hear loud sound as the CP-1's volume advances, stop and reset all rear-panel gain potentiometers fully counterclockwise until they are completely off before proceeding.

With the CP-1's remote volume at -05 dB, slowly advance the rear- panel potentiometer for the MAIN OUTPUTS until the sound is as loud as you will normally play the system. Do not touch the gain on your preamp or receiver after this adjustment. Use only the CP-1 volume control. (Make sure that this level is not high enough to cause speaker distortion or amplifier clipping.)

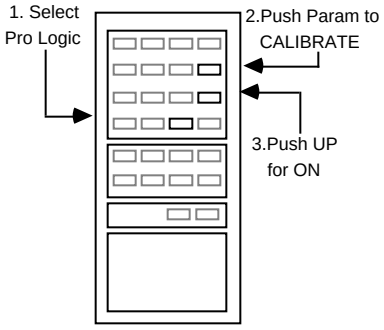
Output Levels

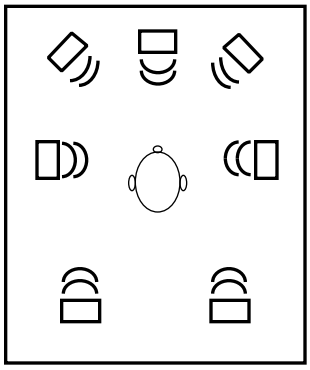


Set Main Output so system is as loud as you are ever going to need it. (Be careful that this level does not cause speaker distortion or amplifier clipping.)

The output level potentiomenters (the small knobs above the output connectors on the CP-1 rear panel) allow you to balance the sound levels of all the channels in your system relative to each other. The most important thing to keep in mind when calibrating the system is to keep these potentiometers set as **low** as possible. Your normal listening level (not background muzak level) shouldbe with the system volume (as indicated by the front panel LCD) set to around -06dB. This keeps the processor at its optimum signal levels while allowing headroom if you really want to crank it up.

Balancing Additional Channels





Adjust other output levels until all directions are equally loud.

If you are using only two audio channels, level adjustment is now complete. If you have additional channels, use the following procedure to set their levels to match the main stereo pair.

Use the VOLUME DOWN button to reduce the CP-1's level to about -20 dB. If the EFFECT MUTE LED is on, push EFFECT MUTE to cancel it. Push program button 12; the display will read: PRESET 12 on the left and SURROUND PRO LOGIC on the right. Push PARAM four times or until the display reads: CALIBRATE. Push PARAM UP to turn on the calibration signal.

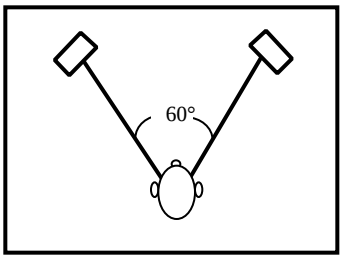
The sound you hear is a band of noise centered around 1 kHz, being sent in sequence to: all channels, left side plus left front, center, right side plus right front and rear channel(s). If you have a center speaker, the rear-panel CENTER/PHANTOM button should be out. Since all levels are down except for MAIN, you will hear only: both fronts, left only, silence, right only, silence. If you have no center speaker, the rear-panel button should be in and you will hear: both fronts, left-only, both fronts,right only, silence.

Now turn on the remaining power amplifiers and turn up SIDE, REAR and CENTER gain until the individual loudness of the sounds reaching your listening position is the same and the all-channel signal is evenly distributed from all speakers. The CALIBRATE ON display will remain for as long as you use this mode. When the front, center, side and rear channels are balanced, press PARAM DOWN to turn off the calibration signal.

Finally, if you are using a separate low-frequency channel, use music or the test signal of your choice to adjust the SUB WOOFER gain until the low bass balances the rest of the spectrum. This completes the initial connections and level adjustments of the CP-1.

Calibration of the Panorama Program

PANORAMA works by canceling the sound going from each speaker to the opposite ear. The effectiveness of the program is highly dependent on the geometry of your front loudspeakers, the room and your listening position. The correct timing of the canceling signal varies with the angle between your main speakers. The SPEAKER ANGLE parameter, displayed in degrees, adjusts for wide or narrow speaker spacing. For the two canceling signals to arrive at both ears at the same time you must be centered precisely between the speakers. The Listener Position parameter (LISTENER POS) delays the corrections from either channel and allows adjustment for an off-center listening chair or for asymmetrical speaker placement.

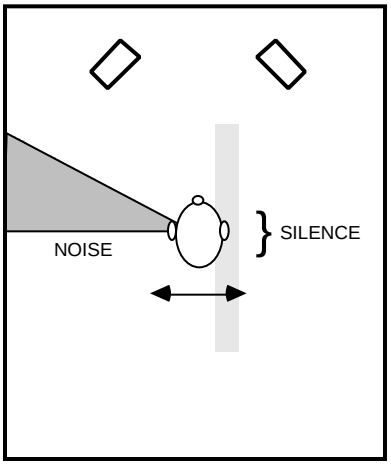


SPEAKER ANGLE is the angle between the main speakers as seen from the listening position -here it is about 60°.

The ideal setup for Panorama is an acoustically dead room, with speakers well away from the walls, and the listener on the center line between the speakers. The effect is diminished by reflections from nearby surfaces. Furthermore, if the listener sees the two speakers from different angles their responses will differ. The addition of acoustic absorption (soft furniture, carpets and drapes) or diffusion (furniture or books that form irregular surfaces and break up reflections) and time spent shifting speakers and chair into more precise alignment (use a tape measure rather than relying on your eyes) will all be rewarded.

Find a mono source, such as an announcer on FM radio or a mono film, and listen for a tightly focused center image of speech or singing. If the image is off-center, adjust the CP-1's BALANCE control. (The narrower the monaural image, the better Panorama will work.) Perform the following setup from a relaxed, comfortable position in your listening chair with your head facing the center point between the speakers.

Select Panorama; Push PARAM to display: CALIBRATE; then push Param UP to: ON LEFT ONLY.



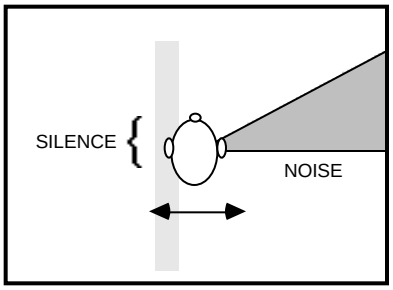
Move your head from side to side to find the position where the noise is full left, and the right ear hears nothing.

1. Reduce the volume to about -20 dB. If the display reads: PRESET at the top left, push Program button 2; if not, push BANK, then button 2 to load PRESET PANORAMA WIDE. Push PARAM eight times (until the display reads: CALIBRATE OFF). Push PARAM UP to turn on the left-channel calibration signal.

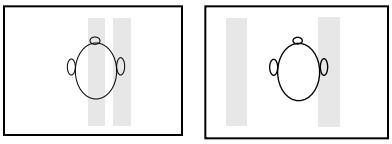
2. The test signal should appear to come from off to your left side, well beyond the left speaker, with near-total silence in the right ear. Still facing forward, move your head from side to side until the effect is strongest. If you can find the *sweet spot* from the confines of your chair, go directly to step 4; otherwise perform step 3.

3. Push PARAM once so the display reads: LISTENER POS. Push PARAM UP and DOWN until you hear the strongest effect. Then push PARAM four times, or until the display reads: CALIBRATE LEFT ONLY.

4. Push PARAM UP until the display reads: CALIBRATE RIGHT ONLY. Again, shift your head from side to side to find the sweet spot, this time looking for the point where the silence in the *left* ear is deepest. Compare the locations of the two sweet spots from steps 2 and 4. If they coincide,



Push PARAM UP again for RIGHT ONLY. If your left ear is in the silent band, the speaker angle is correct. Repeat for the right side.



If the two silent bands are too close, raise SPEAKER ANGLE; if too far apart, lower SPEAKER ANGLE.

To store, see page 29.

go on to step 6; otherwise, perform step 5.

5. Push PARAM twice so the display reads: SPEAKER ANGLE. If the sweet spot from step 2 (LEFT ONLY) is to the left of the sweet spot from step 4 (Right ONLY), push PARAM UP once. If the the step 2 sweet spot is to the right of the step 4 sweet spot, push PARAM DOWN. Push PARAM to return to CALIBRATE RIGHT ONLY and go back to step 2.

6. Adjust your chair so the single sweet spot is in the center, or use PARAM to get to LISTENER POS and adjust this parameter to move the sweet spot to where you want it. Use PARAM to step to CALIBRATE and push PARAM DOWN until the calibration signal goes off.

The Panorama Program is now calibrated. To store it, see page 27. Use PARAM to display the final values of LISTENER POS and SPEAKER ANGLE. Note these values and use them for all forms of Panorama, including the Panorama subsections of AMBIENCE and REVERB.

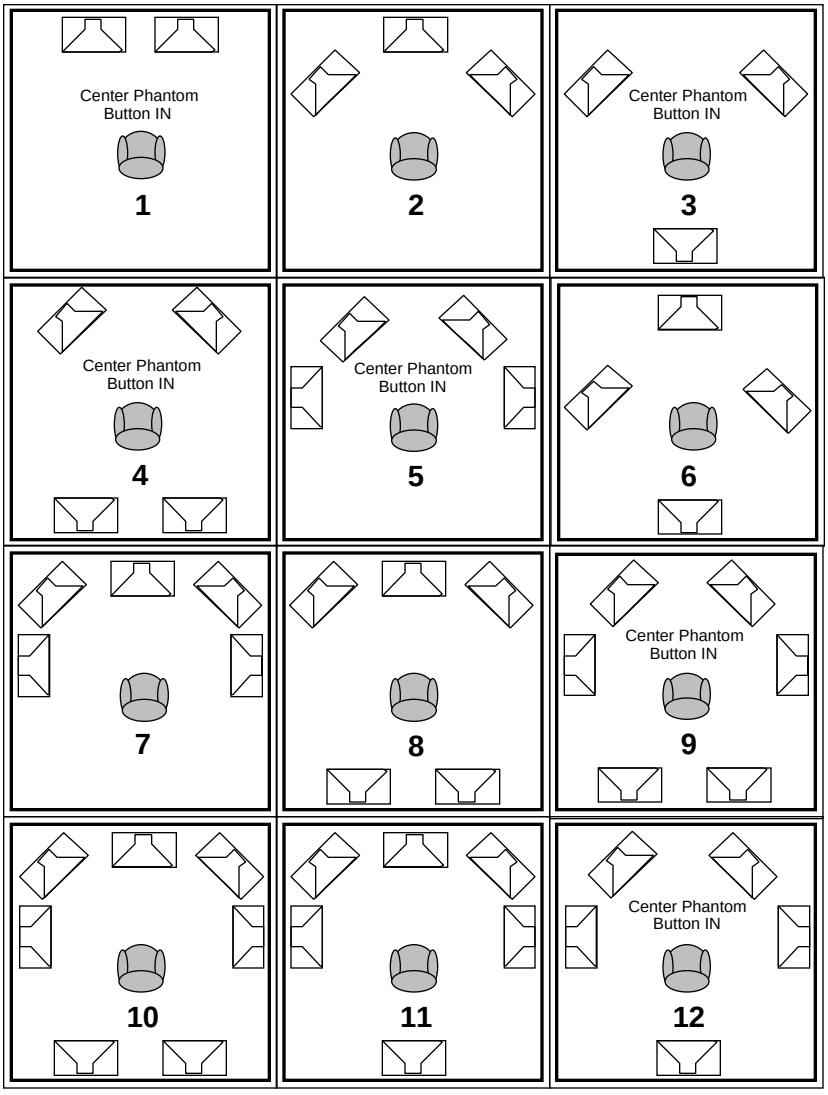
Configuration

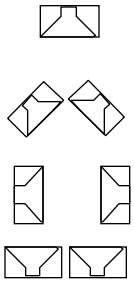
Choose the diagram from the Speaker Configuration Chart that corresponds to your room and note its number. Press the BANK button and hold it for a few seconds. The display will read: LCD CONTRAST ADJ with a bright bar. The CP-1 is now in Configuration mode. Within this mode, operations are carried out using only the three PARAM buttons. Configuration mode will be canceled if any other button is pressed or if 10 seconds pass without a button push.

Speaker Configurations

Subwoofers are not shown in any of these configurations. Consult the subwoofer owner's manual or your dealer for proper placement of subwoofers, remembering that corners are almost always best.

Side and rear speakers may sound better if mounted above the listener, (See Page 15.)





speaker connected to center output

speakers connected to Main outputs

speakers connected to Side outputs

speakers connected to Rear outputs

Press the PARAM UP or DOWN buttons until the contrast of the display is at a maximum as seen from your listening chair. Then push PARAM to enter the Configuration menu. Consulting the Speaker Configuration Chart, push PARAM UP or DOWN until the figure and the description in the display match your room.

Note: If you are using only one rear speaker it may be hooked up to either the left or right rear output, as long as you use the correct Configuration number.

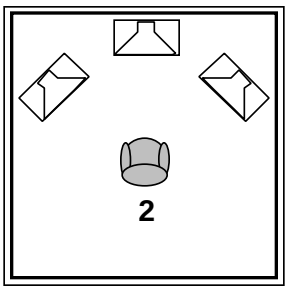
Notes on Amplifiers

How much power do you need? That depends on a number of variables — How efficient are your speakers? How big is the room? How loud do you play the system? Generally, the demands on the side and rear channels are higher for film sound than for music. The center channel is actually the most important channel on most film soundtracks. Your center amp / speaker combination should be able to achieve the same sound pressure levels as the main left and right speakers. Increasing the Bass Blend parameter in the Pro Logic and Stereo Logic modes will help relieve the center channel of the heavy low frequency demands, but is not a suitable substitute for a decent amp / speaker combination. The surrounds will not generally require quite as much power, but there can be substantial energy requirements during crescendos. Consider at least 45-60 watts minimum for your rear channel amplifier.

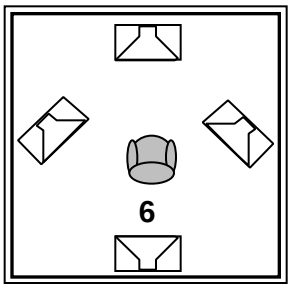
Notes on Speaker Placement

The CP-1's Configuration routine allows a wide range of choices in speaker and room set-ups to maintain optimal performance as your system expands. If you are starting with a conventional two-channel system, in what order should you add additional channels? The answer depends on whether you are primarily interested in audio or video.

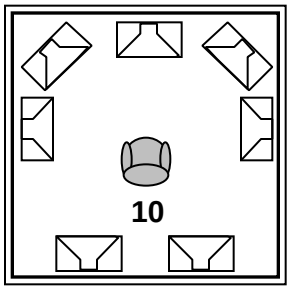
For Film



Good



Better



Best

The film enthusiast with only two stereo speakers should place them relatively close on either side of the screen and use Panorama for both music and films. Beyond this, the very first priority should be a center channel above or below the screen for dialog (Configuration 2). An alternative is Configuration 3, in which two front speakers and one rear are used with either the Panorama or Pro Logic programs.

A dramatic improvement will be noticed when increasing from two or three speakers to four. These should be arranged as in Configuration 6, but with the front left and right speakers spread quite wide, perhaps all the way around to the sides — making a diamond pattern with the listener in the center. How widely you space the front channels will depend on how deeply immersed in the sound track you want to be; the full diamond configuration can considerably heighten the sense of emotional involvement in many movies. This arrangement has the advantage of using amplifiers and speakers in pairs.

If your center channel speaker is smaller than the left and right fronts, increasing BASS BLEND will remove low bass from the center and increase it in the left and right speakers. The center channel is so important that if it is not possible to have an extra center speaker it is frequently better to plug the center output of the CP-1 into the audio input of your video monitor and use its built-in speaker (if it has one) than it is to run the dialog through the main loudspeakers.

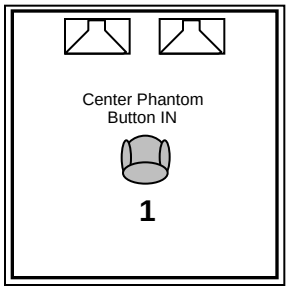
If the system will have a direct view (as opposed to projection) television, a shielded speaker must be used to prevent interference with the picture. Only **one** speaker should be used, as using two speakers to reproduce a mono signal may cause loss of intelligiblity through inter-speaker interference (comb filtering).

The center speaker should be placed as close to the TV as possible, and as close to the horizontal axis of the main speaker's tweeters as possible. Side speakers should be at the sides, or a little forward, of the listening position. If the system is for music only (no film), the sides can be as far as 20 degrees behind the listener. For film use, they should be slightly ahead of the listener. Place the sides at, or slightly above, ear level. Ceiling placement is not recommended, as this will reduce the stereo separation and will be quite strange for film, where Pro Logic sends the same information to the sides and fronts. The rears should be separated as much as possible and kept away from the listener. Here, ceiling mounts are acceptable, as is mounting hig (or in) the rear or back side walls.

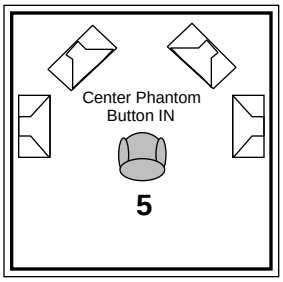
The best set-up for those who like both music and films is Configuration 10. The addition of side speakers allows all forms of source material to be palyed without compromise.

The button on the back of the CP-1 labeled CENTER OUT/PHANTOM IN is very important in the operation of the Surround programs. Make sure the button is <u>out</u> if you have a center speaker and <u>in</u> if you have none. With the button in (Phantom Mode) the center channel is mixed in with the two main outputs; the side outputs carry the Left and Right signals; the center channel is turned off.

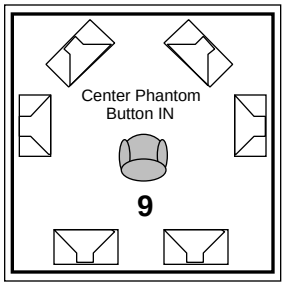
For Music



Good



Better



Best

If your main interest is music, you will most likely begin with two high-quality main speakers (Configuration 1). Here the Panorama program alone will add substantial enhancement in spatial impression, image size, image depth and freedom from coloration of central sources.

The audiophile's first addition should be two side channels (Configuration 5) and, after that, two rear channels (Configuration 9). For maximum effect with the Reverberation programs, two additional speakers can be placed in the front corners of the room, driven from the rear amplifiers. The side speakers, however, are the most important.

With Configuration 5, movies can be played with the Pro Logic program; the rear-channel sound will automatically be routed to the side speakers. If you have six speakers (Configuration 9) an additional stereo amplifier can power both a center channel and a subwoofer.

The height of the extra speakers will depend on the furnishings in the room. In real halls much of the reflected energy comes from above, and placing the side and rear speakers above the listener can be very effective. They also work well on normal speaker stands. Placing the speakers too high in a narrow room may reduce the spaciousness, since this makes the sound come from the ceiling instead of the side walls.

Subwoofer Connections

The Subwoofer Output is a monaural signal created by summing the left, right and center outputs, then filtering out frequencies above 100 Hz at a rate of 12 dB per octave.

Connecting a subwoofer to the CP-1 rear-panel Subwoofer Output, adds bass energy without removing any from your main speakers. Note, however, that many of the subwoofers curently on the market have their own crossover (complementary low and high pass filters) and amp built in. Often it is better *not* to use the CP-1 Subwoofer output (which is already filtered at 100Hz 12dB/octave). Instead, we recommend using the main outputs as follows.

Connect the CP-1 main (front) and left and right outputs to the inputs of the subwoofer crossover. Then connect the subwoofer output (high pass filtered version of the input) to the amplifier driving the main speakers. This has the advantage of bi-amping the main speakers — all the low bass is handled by the subwoofer and the main speakers only handle mid-bass on up. This usually reasults in a better-sounding main speaker.

If you want to run the main speakers full range, the subwoofer can be wired in parallel to the main amp using a Y-connector. Alternatively, the CP-1 Subwoofer ouput can, of course, be used. If there is not enough gain for the subwoofer (because it's being filtered by both the CP-1 and its own crossover), use one of the methods described above.

Since the center channel will still be runing full range, you should use the Bass Blend parameter in the Pro Logic and Stereo Logic modes. This protects the center channel speaker by splitting low frequencies off the center channel and feeding them to the left and right front outputs. Remember to turn up this parameter in any User Register you program, particularly in Stereo Logic. A little experimentation goes a long way in determining the optimum value for Bass Blend. Around 6 is usually best. When this parameter is set too high, some male vocals will sound chesty; too low and you lose bass.

The CP-1 contains four basic programs: Panorama, Ambience, Reverb and Surround. Each program has three variations which occupy one row on the remote control.

Pushing one of the buttons numbered 1 through 12 during normal operation will load that program. Whenever the CP-1 is turned on, it will load the program that was running when it was turned off.

Each program has a number of parameters that you can vary with the three PARAMETER keys. The parameters for each program are listed in the section on individual programs. The PARAM key displays the current parameter and its value for about five seconds. If PARAM is pushed during this period it will select the next parameter. Pushing the PARAM UP or DOWN keys at any time will display and change the parameter's value in the direction you have selected.

The CP-1 contains a total of 24 program registers organized into two banks of 12 each. Each of the 12 program buttons, therefore, will load one of the factory presets or one of the 12 user registers, depending on which bank is currently in use. The factory preset programs are denoted by: PRESET in the upper left of the display, with the program number beneath. The program title appears in the right half of the display, with the basic program name above and the variation below. The BANK button switches between whichever of the 12 PRESET variations is running and the corresponding USER register or vice-versa. For example, if you are running USER 7, pressing BANK will switch to PRESET 7.

While running a Preset program you can change any of its parameters to see how they affect the sound. These changes will be lost when you turn the CP-1 off or change programs, unless you explicitly store the changes. (See page 27.)**Changes made in the value of parameters within a User program, however, are stored with that program immediately and automatically.** This includes settings of EFFECT LEVEL and FRONT/REAR BALANCE but not of the LEFT/RIGHT BALANCE or VOLUME controls. You do not have to perform any specific storage routine to create a new variation in a User register; it happens whenever you change a parameter.

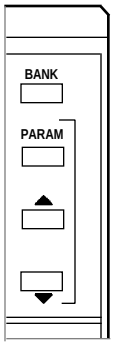
When the CP-1 leaves the factory each User register contains a duplicate of the Preset program of the same number. If you maintain this arrangement, the labels on the remote will continue to describe the contents of both registers. You can, however, store a version of any program in any of the User registers.

The CP-1's User registers can be cleared and reloaded with duplicates of the factory Preset programs at any time. Press and hold the PARAM key while you turn the CP-1 on; continue to hold down PARAM for 5 seconds. This puts the unit into TEST mode. Push EFFECT MUTE to clear and reload the User registers and to restore all initial settings of Volume, Balance, Contrast, Configuration, etc. The display will read: RESTORE DEFAULTS. Push PARAM again to begin normal operation.

To Load, Modify and Store Programs

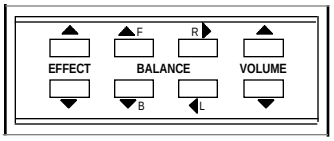
To load a program:

1. Push BANK to select USER or PRESET



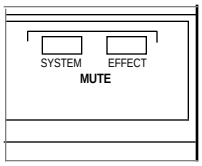
2. Push a program # to load.

3. Changes to PARAM, EFFECT LEVEL and F/B BALANCE store automatically in USER Bank.



4. To store changes for a PRESET Bank program, see page 27.

Test Mode



Panorama

Panorama extracts the natural ambience from recorded music and moves it outward from the speakers, producing greater width and depth of image and a feeling of enhanced spaciousness. The program adds no additional sound but expands the existing stereo image. Panorama also works with Dolby Stereo movies, bringing the surround track outward into the room.

Panorama works with just two loudspeakers. If side speakers present, Panorama disables them and substitutes its own simulation. The front speakers are driven entirely from the CP-1's digital circuits. Panorama will also send a stereo difference signal (left channel minus right or vice-versa) to the rear loudspeakers if you have them. NORMAL (1) will provide enough expansion for most music, while WIDE (2) has a more pronounced effect on the image. BINAURAL (3) has special low-frequency compensation and is meant specifically for true binaural recordings made with a dummy head.

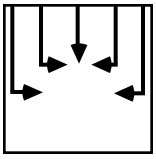
Panorama NORMAL is designed to work with recordings whose bass energy is evenly distributed across the stereo image. Panorama WIDE is designed for recordings with centered bass (almost all pop and rock). The only other difference between these two programs is their initial EFFECT LEVEL. If you need more bass from Panorama NORMAL, switch to WIDE and reduce the EFFECT LEVEL. Conversely, if Panorama WIDE is too bass-heavy, switch to NORMAL and increase the EFFECT LEVEL.

Note The location of the front speakers and the listening position are crucial to Panorama's effectiveness and for best results your system and the CP-1 together should be set up and calibrated according to the procedure on page 10. The strength of the Panorama effect drops off as you move away from the prime listening position, especially to the sides. Video systems with the main loudspeakers spaced closely on either side of a TV screen will produce a diminished effect over a somewhat wider area than set-ups with a large included angle between the speakers.

Program Parameters

Parameter	Initial Value	Range
INPUT BALANCE	(Centered)	Full Left-Full Right
LISTENER POS	127	0-254
SPEAKER ANGLE	49 degrees	29-90 degrees
LF WIDTH	0	-25 - +25
REAR LEVEL	16*	0-32
REAR ROLLOFF	2.9 kHz	329 Hz-14.1 kHz
REAR DELAY	16 ms	0-32 ms
CALIBRATE	OFF	Left, Right, Both
SET PROGRAM NAME	NA	NA
MEMORIZE PROGRAM	NA	NA

* 0 in BINAURAL, or if no rear speakers specified



Effect Level

EFFECT LEVEL sets the amount of crosstalk cancellation, and thus the apparent front width. It is the most important user adjustment to Panorama, and has been given its own button on the remote. When EFFECT LEVEL is all the way down, Input Balance, LF Width and the rear outputs are still active.

Input Balance

INPUT BALANCE compensates for the occasional source with audible channel imbalance. It is especially important when using Panorama for movies. If the movie sound tracks are unbalanced, the dialog will wander away from the center; adjusting the Input Balance corrects for this.

Listener Position/ Speaker Angle

LISTENER POS and SPEAKER ANGLE are determined using the calibration procedure on page 10. The resulting value for Listener Position should then be used for the Panorama sections of Ambience and Reverb.

LF Width

LF WIDTH controls the amount of low-frequency spatial correction that is applied to the signal. A positive value of LF WIDTH means the difference (left minus right channel) signal has additional energy below 500 Hz, while the sum (left plus right) signal has correspondingly less. (Negative settings can compensate for recordings with too much of this property.) LF WIDTH can add needed spaciousness and warmth to classical recordings made with coincident or near-coincident miking. (See Chapter 5: Theory and Design.)

Rear Level

REAR LEVEL adjusts the loudness of the signals sent to the rear channels.

Rear Delay

REAR DELAY adjusts the amount of time between the appearance of a signal in the front channels and its emergence from the rear. Generally, the correct delay is about 16 milliseconds but the setting depends on speaker set-up and source material. In general, the delay should not be so great that the rear sound becomes identifiable as a distinct source.

Rear Rolloff

REAR ROLLOFF sets the frequency above which the rear-channel sound is attenuated. It should be high enough to give presence and airiness to the rear sound but not so high as to place distracting instrumental overtones or other sounds behind you. The appropriate setting will vary with program material.

Calibrate

The use of the CALIBRATE mode is described in the setup instructions beginning on page 11.

Set Program Name/ Memorize Program

The procedures for naming a new version of the program (SET PROGRAM NAME) and storing it in one of the User registers (MEMORIZE PROGRAM) are described on page 29.

Ambience

Ambience generates the appropriate early reflections for stereo simulation of one of six different halls — one rectangular hall and one fan-shaped hall in small, medium and large sizes — and sends the reflections to the side and rear speakers. For systems with only two loudspeakers, Ambience also incorporates a version of Panorama that will spread the stereo image and add the reflections it generates to the expanded sound stage.

The initial EFFECT LEVEL is highest for Program 4 and progressively lower for Programs 5 and 6. It will be easier to hear exactly what the parameters do if the effect level is temporarily turned all the way up.

Program Parameters

Parameter	Initial Value	Range
ROOM SHAPE	Rectangle	Rectangle, Fan
LIVENESS	4	0-6
ROLLOFF	s/m/l=5.9/3.6/2.9 kHz	329 Hz-14.1 kHz
PANORAMA EFF	28*	0-32
LISTENER POS	128	0-254
SPEAKER ANGLE	51 degrees	33-91 degrees
SPEECH DETECTION	ON	On/Off
SET PROGRAM NAME	NA	NA
MEMORIZE PROGRAM	NA	NA

* 0 if side speakers are specified

Effect Level

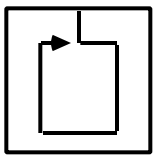
EFFECT LEVEL adjusts the loudness of the side and rear speakers. When there are no side speakers, it adjusts the amount of ambient signal mixed into the main loudspeakers. EFFECT LEVEL is the most important user adjustment in AMBIENCE and REVERB, and has been given its own button on the remote. It should be adjusted as high as possible without making the extra speakers individually audible.

Room Shape

ROOM SHAPE selects one of two basic hall shapes. Refer to Chapter 5: Theory and Design, for a discussion of the properties of the two.

Liveness

The LIVENESS parameter adjusts the amount of recirculation within the program. The higher the value, the more reflective the surfaces of the simulated space and the longer the sound will take to decay. At very high values the decay is audibly less smooth than in the Reverb programs, which are more effective at simulating very live spaces.



Rolloff

ROLLOFF mimics the absorption of the air in the hall and its initial value is therefore more pronounced (the rolloff begins at a lower frequency) the larger the space.

Panorama Effect

PANORAMA EFFECT adjusts the strength of the signal used to expand the stereo image outward from the front two speakers. It is only needed when side speakers are absent.

Listener Position

LISTENER POS compensates for the relative distance of the two main speakers from the prime listening area. It should be set for the value arrived at in the Panorama set-up procedure on page 11.

Speaker Angle

SPEAKER ANGLE compensates for differing distances between your front speakers. It affects only the Panorama Effect and is only needed when side speakers are absent. The Speaker Angle can be set to the value reached in the setup procedure on page 11, but the program may also work well at lower values.

The image expansion will be strongest at the one location in the room for which the program has been calibrated (See page 10). It will diminish somewhat as you move forward or back from that location and more rapidly as you move from side to side.

Speech Detection

The Speech Detection circuit distinguishes monaural speech from other inputs. Whenever stereo signals are present, the right and left input channels are used independently as inputs to the ambience synthesis. If there is a strong monaural speaking voice present at the same time, this component of the input is reduced while the stereo component is increased. If the input signal is pure monaural speech the input is almost entirely attenuated.

SPEECH DETECTION is a real benefit to some popular music (where spoken voice, such as rap, occurs along with music), stereo television, and early stereo movies. Any stereo material which was not carefully mixed for Surround is a good candidate for playing through Ambience with SPEECH DETECTION On.

Set Program Name/ Memorize Program

The procedures for naming a new version of the program (SET PROGRAM NAME) and storing it in one of the User registers (MEMORIZE PROGRAM) are described on page 29.

Reverb

The Reverberation program differs from Ambience in that it does not simulate the early reflections of specific halls, but emphasizes rich, smooth reverberant decay in small, medium or large spaces. It works well for simulating a space with a long reverberation times relative to its size, such as a reverberant chamber, church or the like. For systems with only two loudspeakers, Reverb also incorporates a version of Panorama that will spread the stereo image and add the reflections it generates to the expanded sound stage.

The initial EFFECT LEVEL is highest for Program 7 and progressively lower for Programs 8 and 9. It will be easier to hear exactly what the parameters do if the EFFECT LEVEL is temporarily turned all the way up.

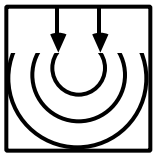
Program Parameters

Parameter	Initial Value	Range
MID RT	small-0.46 sec	0.32 - 2.8 sec
	medium - 0.92 sec	0.64 - 5.6 sec
	large - 2.16 sec	1.28 - 11.2 sec
BASS RT	small-x1 MID RT	0.7 xMID RT
	medium-1.25xMID RT	1 xMID RT
	large-1.25xMID RT	1.25xMID RT
TREBLE	s/m/l=5.9/4.2/3.6 kHz	329 Hz - 14.1 kHz
PANORAMA EFF	0/28*	1-32
LISTENER POS	128	0-254
SPEAKER ANGLE	51 degrees	33-91 degrees
PRE-DELAY	0	0-120 ms
SET PROGRAM NAME	NA	NA
MEMORIZE PROGRAM	NA	NA

* 0 if side speakers are specified

Effect Level

EFFECT LEVEL adjusts the loudness of the side and rear speakers. When there are no side speakers, it adjusts the amount of ambient signal mixed into the main loudspeakers. EFFECT LEVEL is the most important user adjustment in AMBIENCE and REVERB, and has been given its own button on the remote. It should be set as high as possible without making the extra speakers individually audible.



Mid RT

MID RT (Midrange Reverberation Time) is the time required for midrange sounds to decay 60 dB in level. Your choice of small, medium or large synthesized space determines both the initial value and the available range of MID RT.

Bass RT

BASS RT, the low-frequency reverb time, depends on the MID RT and is expressed as a multiplier. BASS RT is equal to MID RT in Program 7, while in the medium and large versions of the program it is 25% higher (as is the case in most actual halls with acceptably warm subjective frequency balance).

Treble

TREBLE rolloff, as in the Ambience programs, is preset to mimic air absorption in actual spaces, being more pronounced in the larger ones.

Panorama Effect

PANORAMA EFFECT adjusts the strength of the signal used to expand the stereo image outward from the front two speakers. Its initial value is zero, unless you have configured the CP-1 for no side loudspeakers.

Listener Position

LISTENER POS compensates for the relative distances of the two speakers from the prime listening area. It should be set for the value arrived at in the Panorama set-up procedure on page 11.

Speaker Angle

SPEAKER ANGLE compensates for varying distance between your front speakers. The Speaker Angle can be set to the value reached in the setup procedure on page 11, but the program may also work well at lower values.

The image expansion is strongest at the one location in the room for which the program has been calibrated. (See page 11.) It will diminish somewhat as you move forward or back from that location, and more rapidly as you move from side to side.

Pre-Delay

PRE-DELAY increases the delay between the direct sound and the onset of reverberation. Some pre-delay is inherent in the programs, and the preset value of 0 is usually a good starting point. Increasing the pre-delay will make the hall sound larger.

Set Program Name/ Memorize Program

The procedures for naming a new version of the program (SET PROGRAM NAME) and storing it in one of the User registers (MEMORIZE PROGRAM) are described on page 29.

Surround

The SURROUND programs are designed for film sound tracks and they make full use of additional loudspeakers at the center, sides and rear of the room. MONO LOGIC takes a monaural soundtrack and sends music and sound effects to the sides and rear through a room simulator program, while keeping dialog in the center. STEREO LOGIC is meant for playing music through a system whose speakers are laid out primarily for films. PRO LOGIC is Lexicon's all-digital implementation of the Dolby Pro Logic Surround decoding process.

> The term Dolby Stereo refers to both movies and equipment used exclusively for theatrical presentation. When one of these movies is transferred to commercial video media, the special audio encoding of the Dolby Motion Picture matrix is retained in the two-channel stereo soundtrack. The resulting video software and the hardware designed to reproduce it use the name Dolby Surround to distinguish it from the theatrical optical format.
>
> Dolby Pro Logic Surround decoding is the licensed consumer version of the professional Dolby Stereo cinema processors, which allows the home viewer to obtain all the spatial effects of the soundtrack heard in a theatre over a wider range of seating positions than conventional Dolby Surround playback.

Effect Level

EFFECT LEVEL conrols the level of all channels *except* the center. The center will appear stronger if you turn down EFFECT LEVEL a few dB. With EFFECT LEVEL all the way down, the center only will play.

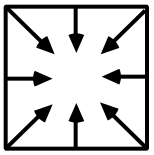
Program Parameters

Mono Logic

Parameter	Initial Value	Range
TREBLE	2.3 kHz	329 Hz - 14.1 kHz
SET PROGRAM NAME	NA	NA
MEMORIZE PROGRAM	NA	NA

Treble

TREBLE is the only adjustable parameter in MONO LOGIC. It regulates the treble cut in the side and rear channels. The optimal setting for this parameter will vary widely with the age, quality and condition of the source material.



Stereo Logic

Parameter	Initial Value	Range
FRONT EFFECT	8	0-16
REAR EFFECT	8*	0-16
REAR ROLLOFF	14.1 kHz	329 Hz-14.1 kHz
		Automatic
BASS BLEND	0	0-16
AUTO AZIMUTH/BAL	OFF	Off, On
REAR DELAY	8 ms	0-32 ms
REAR NOISE CHIP	OFF	Off, On
CALIBRATE	OFF	Off, On
SET PROGRAM NAME	NA	NA
MEMORIZE PROGRAM	NA	NA

* 0 if no rear speakers specified

Pro Logic

Parameter	Initial Value	Range
REAR DELAY	20 ms	16-32 ms
AUTO AZIMUTH/BAL	On	Off, On
BASS BLEND	6	0-16
CALIBRATE	Off	Off, On
SET PROGRAM NAME	NA	NA
MEMORIZE PROGRAM	NA	NA

Rear Delay

REAR DELAY in both STEREO LOGIC and PRO LOGIC is adjustable. Generally, the correct delay is about 20 milliseconds but the setting depends on speaker set-up and source material. In general, the delay should not be so great that the rear sound becomes identifiable as a distinct source.

Rear Rolloff

REAR ROLLOFF controls the treble attenuation and should be adjusted on music for maximum airiness and spatial realism without causing specific instruments to seem to come from behind you. Stereo Logic's REAR ROLLOFF parameter contains an AUTOMATIC mode. In this mode the rear channels are rolled off above 7 kHz until the logic circuits steer a sound effect to the rear speakers, whereupon the bandwidth opens up to beyond 15 kHz. This will enhance the realism of some effects that move from front to rear or vice-versa.

Program Parameters cont'd

Auto Azimuth/ Balance

The AUTO AZIMUTH/BAL parameter should be set to ON for films, OFF for music. When it is on, special digital circuits continually monitor the dialog and adjust both the relative level and time offset of the two channels to keep the dialog properly centered. This automatic feature is why the CP-1 does not have or need a front-panel input balance control for Dolby Surround decoding.

Bass Blend

BASS BLEND takes the low bass from the center, where it is in many film and music mixes, and distributes it instead to the left and right front-channel speakers. Its initial value is 0 in the Stereo Logic program and 6 in Pro Logic. This is valuable because in many video installations the center speaker is smaller than the two main stereo speakers and is, therefore, less capable of handling the lowest frequencies.

Front Effect/ Rear Effect

The essence of the Dolby PRO LOGIC circuit is that dialog, music and sound effects are dynamically directed to the output channels, a process called steering. The FRONT EFFECT and REAR EFFECT parameters in Stereo Logic allow you to adjust the amount of this steering. Both are preset for their maximum values in PRO LOGIC. In STEREO LOGIC, FRONT EFFECT has a default value of 8, which is equivalent to 6 dB of steering; at this level, central (monaural) sources are reduced in level by 6 dB in the main stereo speakers. With FRONT and REAR EFFECT both set to 0, STEREO LOGIC becomes the equivalent of a simple non-steered Dolby Surround decoder. If you have no rear speakers, REAR EFFECT should be set to 0. The CP-1 will set this parameter automatically when you specify a speaker configuration with no rear channels. (See page 13.)

Rear Noise Chip

Dolby Surround decoding specifications call for a special form of Dolby B-type noise reduction. Because STEREO LOGIC is also meant for music, the rear-channel sound has more flexibility, including REAR NOISE CHIP, a parameter that allows you to turn this Dolby NR circuit off.

Calibrate

The CALIBRATE mode in Stereo Logic and Pro Logic is for setting up and checking the levels of the channels in multi-speaker systems. Its use is covered in the section on Balancing Additional Channels on page 10.

Set Program Name/ Memorize Program

The procedures for naming a new version of the program (SET PROGRAM NAME) and storing it in one of the User registers (MEMORIZE PROGRAM) are described on page 29.

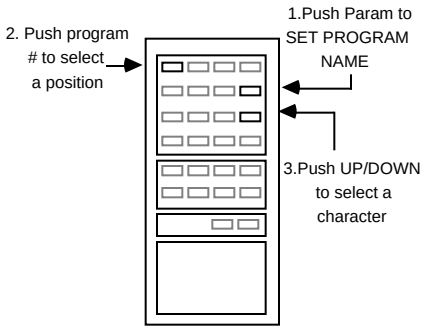
To Rename and Store a Register

USER banks store automatically.

The previous sections describe the CP-1's four basic programs and all of their variable parameters. Any changes in the parameters of a program in the USER bank will be automatically recorded and stored for future use. The CP-1 also allows you to store a new version of any PRESET or USER program in any USER register.

Naming a Register

As you cycle through the parameters in any program with the PARAM key you will come to two labeled: SET PROGRAM NAME and MEMORIZE PROGRAM. To rename your new program, press the PARAM key until the display reads: SET PROGRAM NAME. At this point a cursor (the underline character) appears in the bottom row of the LCD display. Each of the 12 program keys will now move the cursor to one of twelve available spaces in the display, while the PARAM UP and DOWN keys cycle through the available list of characters, beginning with the one currently occupying the space.



With the upper half of the display reading: SET PROGRAM NAME, push 1 on the remote (also marked PANORAMA NORMAL). The cursor will move to the leftmost column of the program name. Now push PARAM UP or DOWN until the character you want appears in the space. (Holding either button for one second activates an auto-repeat mode to speed you through the list.) All letters are available, in upper or lower case, as are digits 0-9, a blank space and an assortment of other characters. When the first space in the display is correct, press button 2, set the second character and repeat until the new name is complete.

Storing a Register

As with all the other parameters, a new name composed while a USER program is running becomes a permanent part of the CP-1's memory as it is being written. If you began with a PRESET program, storing a register takes two more steps: Press PARAM until the display reads MEMORIZE PROGRAM, then press any of the 12 program keys to store all current settings in the corresponding USER register. This operation will also switch the CP-1 to the selected location in the USER bank, causing further pushes of the program keys to load USER programs instead of PRESETs. (Press BANK again to return to the factory presets.)

1. Push PARAM to MEMORIZE PROGRAM

2. Push any program # to STORE

Restoring Original Settings

When a PRESET program is running and parameters have been changed, you can restore the original settings simply by pushing the button for the displayed program number again. To experiment with a USER program without changing it requires that you set aside one register for experiments. If, for example, this "scratch register" is number 12, call up the program you want to start with, cycle through its parameters until you come to MEMORIZE PROGRAM and press button 12. This will make a duplicate of the original program in USER register 12, and switch the CP-1 to USER 12. The parameters of the duplicate can now be modified at will and the new version stored in any USER register.

See also TEST MODE, page 17.

Troubleshooting

If you encounter a problem, please review the items in the following checklist. Also be sure to thoroughly check all other connected components such as speakers, receiver / amplifier / preamp, VCR, TV, CD player, etc.

Problem	Possible Cause and Solution
Input level meters not functioning	Make sure INPUT LEVEL on the CP-1 front panel is turned up. Check the connections on the rear and make sure signal is going into the CP-1. Check SOURCE and MONITOR switches and try toggling them in and out. Make sure that the correct input is selected and that only one input button is depressed.
Remote control not working	Check the batteries and make sure that they are inserted correctly with proper polarity. Make sure that the infrared receiver on the CP-1 front panel above the POWER switch is not obstructed. If the remote control unit is still not functioning, RESTORE DEFAULTS as described below.
No audio	Check input and output connections. They may be reversed relative to the IN and OUT jacks of your receiver / amplifier / preamp or other source.
Erratic behavior	Power turn-on with large power amps may cause power sags that will confuse the CP-1. To prevent this, plug the CP-1 into an AC outlet on a different branch circuit, or turn on one amplifier at a time.
No output	First verify that signal is coming into the CP-1 by observing the Input Level meters. Increase VOLUME using the Remote Control and check the Front / Back and Left / Right balances. Make sure that the rear panel Output Level controls are turned up. Check the CP-1 mute controls to make sure they are not engaged. Check all other equipment settings and connections and verify that the amplifier(s) being fed by the CP-1 are operational.
Display irregularities	Adjust the contrast (relative brightness) of the display using the procedure described on the Quick Reference Guide, and on Page 13 of the Owner's Manual. If the display is showing strange characters, RESTORE DEFAULTS as describet the end of this section.
Center channel only plays	Check to see if your HiFi VCR has dropped out of tracking — readjust. Your VCR Stereo / Mono / L-R switch may be in the wrong position — set it to stereo.

Problem	Possible Cause and Solution
Muffled sound in L&R channels	When no center channel is used, the rear-panel phantom button must be pushed IN.
Center channel sound muffled	The center channel amp may be connected to the subwoofer jack on the CP-1 rear panel. Reconnect to Center Output jack.
Hum	Finding and eliminating audio hum in a complex installation can be a very frustrating task. Often, the easiest way to identify the culprit is to systematically eliminate devices from the audio chain. If Cable TV is connected to any equipment in the system, start by unplugging the Cable completely, preferably right at the wall jack. If this eliminates, or greatly reduces the hum, it's worth a call to your Cable company. A quick fix, assuming your cable is round 75Ω wire, is to attach a 75-300Ω transformer to the end, then attach a 300-75Ω transformer to that, so that the end is back to a round 75Ω wire. There are commercially-available antenna lead isolators which may provide additional insulation from electrical surges.
Balance control doesn't work in Pro Logic or Stereo Logic	If there is no center channel in the system, the center channel output is routed to both the left and right main outputs. This means the left speaker reproduces not only the left channel information, but also the center channel information. If you set the balance all the way over to the right, the left channel information will be attenuated, but the center channel wll still be present at the left speaker. In other words, it's supposed to work that way.
Panorama Calibrate isn't working	Panorama is an interaural crosstalk cancellation program that produces an anti-phase cancellation signal to the opposite speaker. When the calibration mode is in LEFT ONLY, there is still cancellation signal coming out of the right speaker. This is a psychoacoustic phenomenon and LEFT ONLY means the calibration signal should *appear* to come only from the left (usually to the left of the speaker.)
Interference with AM, FM, TV or Cable TV	The CP-1 does generate minimal amounts of RF energy and is in compliance with FCC rules. If some interfering noise is noted, move AM loop and FM "T" type antennas away from the CP-1 and reorient them as necessary. Use shielded cable for FM and antenna feeds.
Erratic recall of programs	Severe power surges or sags can confuse the CP-1 memory. To correct, or if you simply want to start over, restore the factory defaults with the procedure described at the end of this section.

Problem	Possible Cause and Solution
Restoring defaults	If severe power surges or sags cause problems with CP-1 memory storage, or you simply want to start with a clean slate in the User registers, you can restore factory presets into the User registers with the following procedure. **This will erase any programs you have stored in the User register, so you may want to note any settings you wish to re-use before proceeding.** Turn CP-1 power OFF. While pressing PARAM on the Remote Control, turn power ON. (Make sure your hand does not block the infrared receiver on the CP-1 front panel.) Continue holding down PARAM until the display reads: ** TEST MODE ** PRM Key To Exit Release PARAM and press EFFECT MUTE to clear and reload User registers, and to restore all factory settings of Volume, Balance, Contrast, Configuration, etc. The display will read: RESTORE DEFAULTS Press PARAM to restore normal operation. (Remember to check the LCD contrast and Configuration settings, since they will have been reset to factory defaults.) If you cannot solve functional problems through these procedures, consult your dealer or Lexicon / Customer Service Department. **DO NOT, UNDER ANY CIRCUMSTANCES, OPEN THE UNIT. DOING SO WILL VOID YOUR WARRANTY, AND MODIFICATIONS MAY RENDER THE UNIT UNSERVICEABLE.**

Lateral Sound

Concert Hall Acoustics

For decades the study of concert-hall acoustics relied on certain basic measurements to characterize halls, the main one being the time it takes a sound to drop in level (decay) by 60 decibels. This is called the reverberation time or RT_{60} and is approximately the same as the time it takes a hand clap to subside to inaudibility. The RT_{60} is measured as a function of frequency, usually in bands one octave wide, over the range of audible frequencies. The resulting curve forms a frequency contour for the hall.

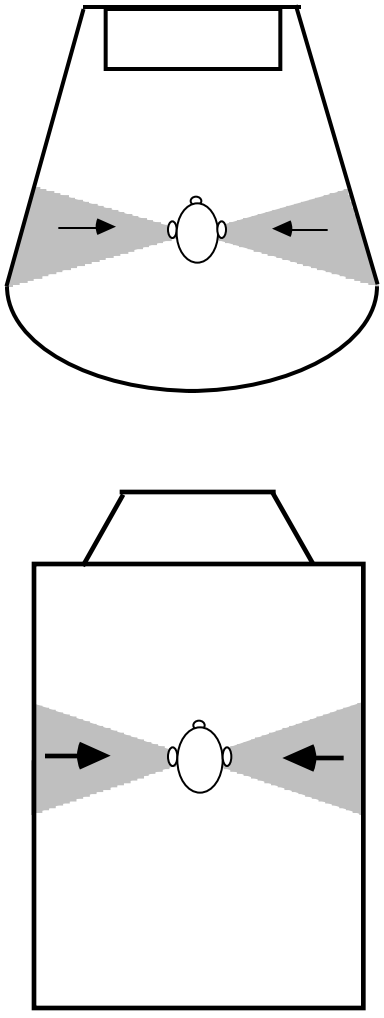
While it was found that most good halls have comparable RT_{60} curves, different halls with similar RT_{60} measurements can sound very different from each other and listener reactions to them can vary widely. Clearly, other important factors in the sound field were not being measured. Through the work of many people (including Manfred Schroeder, A. H. Marshall, Michael Barron and others) some of these factors were identified.

In an effort to answer the question of why some halls sound so much better than others, Schroeder devised a method for comparing them without transporting his subjects from hall to hall. Using a dummy head with microphone diaphragms in place of ear drums, Schroeder made binaural recordings in many halls. These recordings, played back through earphones, gave excellent reproduction of spatial qualities. Unfortunately, the stereo image tended to appear entirely inside the head, spoiling the accuracy of such recordings as a test of concert halls.

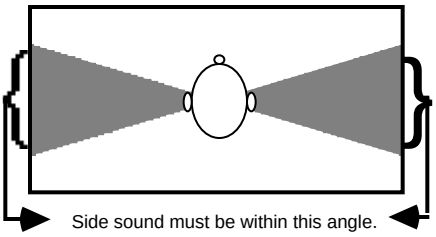
To overcome this problem, Schroeder played his recordings through a pair of loudspeakers in an anechoic chamber, using a special electro-acoustic technique (developed by Atal, Schroeder, Damaske and Mellert) to eliminate crosstalk between the listener's ears. Normally each speaker is heard by both ears but Schroeder's system canceled the sound reaching the right ear from the left speaker and vice-versa. Provided that the listener held his head in exactly the right spot, the sound had all the excellent localization properties of earphones but was properly located outside the listener's head.

This technique allowed the first direct comparisons of specific halls.[1] From these studies it was found that the best halls were all characterized by having large *differences* in the sound between the two ears in the dummy head. Very simply, the best halls gave the most stereo.

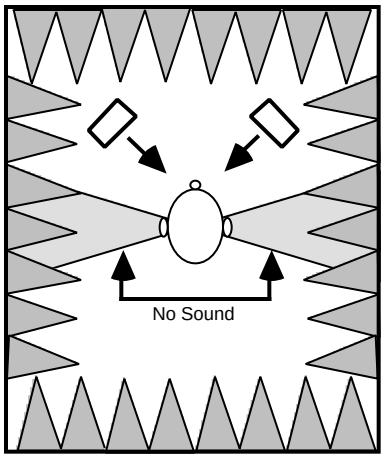
Michael Barron defined this characteristic in halls as Spatial Impression (SI) and found that it was created by sideways-moving reflected sound.[2] Only reflections which move from side to side produce SI, because only they give rise to sound differences between the two ears. Reflections from the front, ceiling, floor or back wall add loudness and muddiness to the sound but it is the lateral reflections that draw the listener into the music.



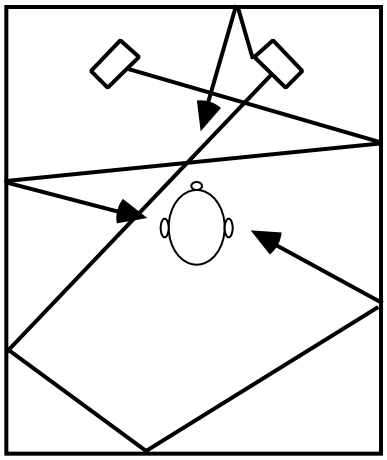
Halls with similar RT_{60} sound very different. The best have large amounts of sideways moving reflected sound.



Sound from the side is vital to listener comfort and involvement....It must really be from the side!



In an anechoic chamber, this sideways sound is missing...and music sounds unpleasant.



In an ordinary room, the room supplies these directions, and the sound is cramped, but tolerable. The overall impression, however, may be muddy due to unwanted frontal reflections.

Understanding the importance of lateral reflections enabled more accurate evaluation of architectural acoustics. The best halls were usually found to have high lateral energy for obvious architectural reasons, such as a long narrow shape with high ceilings. Fan-shaped halls, although they have better sight lines, are more adaptible to multiple uses and hold a greater number of seats for their total volume than a shoe-box hall, tend to have fewer attractive, sideways reflections and more of the unpleasant, monaural overhead and rear-wall kind. These differences can be overcome by design. A notable example is the Boston Symphony's fan-shaped Tanglewood music shed. Tanglewood sounds good because the reflectors above and in front of the orchestra (known as clouds) have angled sides that reflect energy sideways onto the audience instead of just downward.

Lateral Sound in your Listening Environment

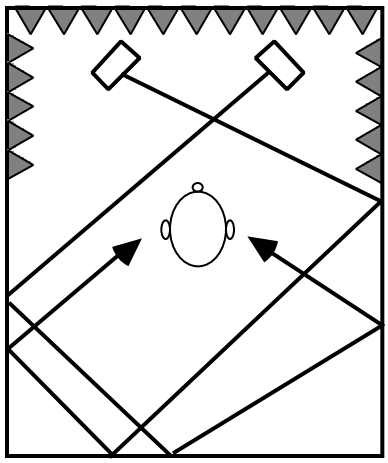
In an ordinary listening room, conventional stereo set-ups (with loudspeakers separated by 60 degrees or less) do not excite enough SI to sound pleasant without some help from the room. (A similar speaker arrangement in the artificial environment of an anechoic chamber is exceedingly detailed and precise, but unpleasant.) Some lateral reflections are needed to make the sound musical.

Ordinary two-speaker stereo works as well as it does because sideways-moving reflections can be excited at low frequencies by two loudspeakers if they are placed asymmetrically in the room or if they are driven with out-of-phase low-frequency information.[3,4] (Out-of-phase bass is intentionally provided in the best stereo recordings.) Another reason is that most listening rooms have reflective surfaces to the sides of the listener. A popular listening room treatment puts absorptive material at the front of the room, leaving the walls by the listener reflective. This improves the clarity by removing the front reflections, while retaining those from the side. This also explains the appeal of loudspeakers that produce lots of sideways-reflected energy.

Unfortunately, in most two-speaker set-ups the mid- and high-frequency lateral sound is reduced unless the speakers are unusually widely placed. The listener can hear a little of the original hall, stretched between the stereo loudspeakers, but never really becomes a part of it. What is worse, the lateral sound that exists in most playback rooms has so little delay that the ear can not separate it from the direct sound. The reflections generate some SI but they also cause coloration and muddiness. Small rooms usually sound better if these reflections are broken up (with wall hangings, furniture or bookcases) or absorbed (with curtains or sound-absorbent panels). When this is done the room becomes quieter and clearer but not in any way like the original hall.

The Lexicon CP-1 resolves this deficiency by supplying appropriate signals to loudspeakers at the sides of the listener or by modifying signals to the main loudspeakers to fool the ear into thinking there are loudspeakers at the

sides. Both methods depend on having the added sound come from a different direction than the original music, and each method has some advantages. With either method of generating SI there is an additional choice the CP-1 allows the user to make: the sideways energy cues of the original recording can be *extracted* by the CP-1, or a different hall sound can be *generated* and supplied from the correct directions.



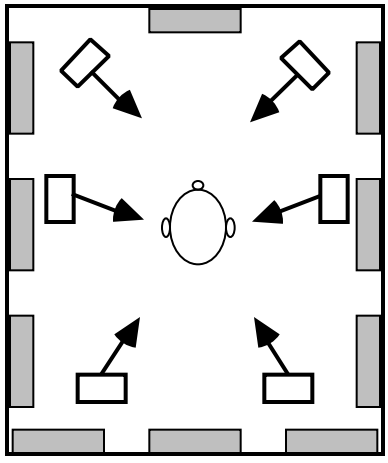
The confusing frontal reflections can be absorbed leaving the essential lateral ones. This is better, but not ideal.

Ambience Extraction

The Panorama and Surround programs in the CP-1 extract the original acoustic cues from the recording and present them to the listener from the correct directions. We call this *ambience extraction*. The three Panorama programs can even do this with only two loudspeakers. Panorama uses crosstalk elimination to fool the ear into thinking there is a continuous band of loudspeakers extending all the way to the sides of the listener and also supplies a delayed and filtered L-R signal to rear speakers. On a good recording this successfully recreates the original recording space, although the ideal listening area may be small.

The Surround programs, Stereo Logic and Pro logic, also work by ambience extraction. They divide the front energy among three or more loudspeakers and supply a delayed and filtered difference signal to rear loudspeakers. Because a center speaker is provided, the left and right speakers can be placed far enough to the sides of the listener to directly excite significant SI and the resulting image is wide but seamless. This set-up can sound similar to Panorama, and it works over a large listening area.

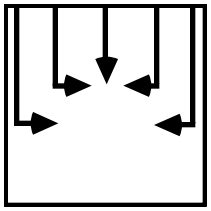
Stereo Logic and Pro Logic also provide steering. Steering works by enhancing the directionality of the loudest sound in a mix; it steers the sound out of loudspeakers where it is not needed and into the ones closest to its direction in the image. In popular music the loudest sound is usually the vocals, which will be preferentially steered toward the center loudspeaker. Some steering is frequently beneficial to music recordings played with a surround speaker arrangement, and it is essential for films.



With the CP-1, confusing short reflections can be absorbed; the CP-1 will supply the essential lateral sound - which can simulate a much larger space.The more absorbent the playback room, the better it will sound, and the closer it will sound to a real hall, or larger environment.

Ambience Generation

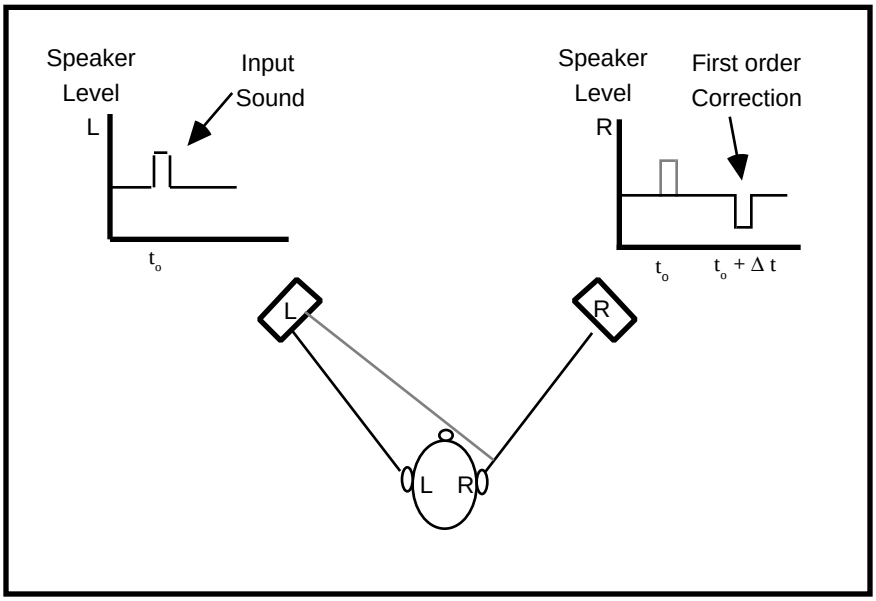
The Reverb and Ambience programs in the CP-1 synthesize the side and rear sound of several different acoustic spaces. Rather than extracting the acoustic cues of the original hall from the recording, they *generate* a new environment, effectively enlarging and improving the acoustics of your listening room. In these programs the original stereo channels are presented unaltered to the main loudspeakers, and new signals are generated for the side and rear loudspeakers. Both Ambience and Reverb can be configured to use a version of Panorama to generate the correct side sound *even when side loudspeakers are absent.* In this mode the side signals are first passed through Panorama before being mixed into the main loudspeakers, so the resulting hall sound is perceived as coming from the side and is well separated from the original sound.



The Panorama Program

Loudspeakers placed on either side of the listening position are the most effective and foolproof way to produce added Spatial Impression. Since it is not always possible to have side loudspeakers, the CP-1 uses crosstalk elimination to simulate them when they can't physically be there. In Panorama the front speakers are driven entirely by the front digital outputs of the CP-1. (Panorama disables any side speakers present, and simulates them electronically.)

Versions of the Atal / Schroeder / Damaske / Mellert technique mentioned earlier have appeared in several consumer signal processors under various trade names, as well as in a line of loudspeakers that achieved a similar effect acoustically. These have all been what we call "first-order" devices. To see what this means, imagine there is a sound coming from the left channel only. This sound will travel to the left ear of the listener, then diffract around the listener's head and be heard by the right ear. If we take the left-channel sound, delay it just the right amount, invert it in phase and feed it to the right speaker, it will arrive at the right ear just in time to cancel the crosstalk from the left speaker.



Imagine a click in the left speaker...

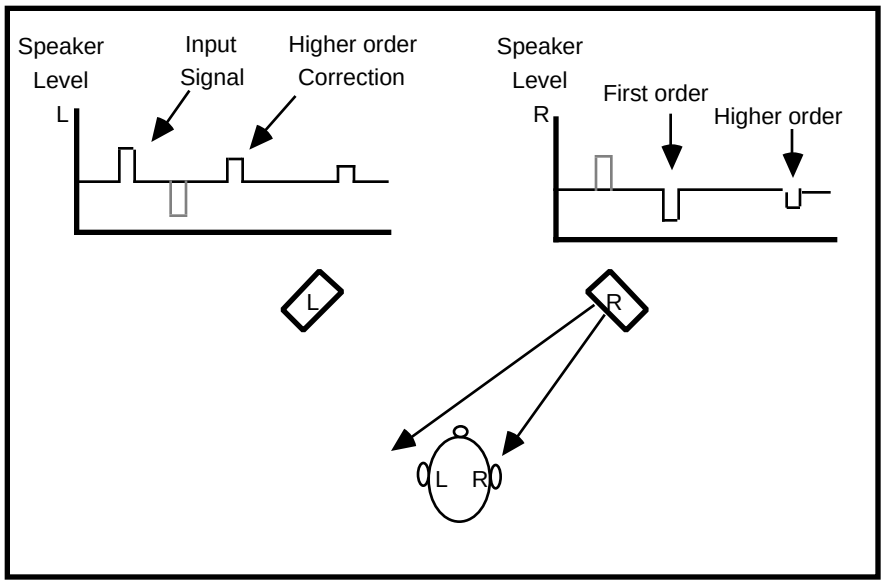
Sound from speaker L travels to the left ear and also to the right ear, a time Δ t later.

If we supply a negative delayed signal to the right speaker, this crosstalk can be canceled.

The main problem with a first-order device is that the subtracting signal is also heard by the opposite ear. In our example, the canceling signal from the right loudspeaker will diffract around the head to the left ear, interfering with the left-speaker sound and producing a "comb filter" which colors the sound in an obvious and unpleasant way. Furthermore, the listener's head is not well represented by a simple delay line. Both the delay and the amplitude of the opposite-ear sound vary in complicated ways with fre-

quency.

Lexicon's implementation, called the Panorama program, was designed using measured data on sound diffraction around the head to shape the frequency spectrum of the canceling signal. This signal is then itself canceled by a second signal, and so on, so that both the crosstalk and the

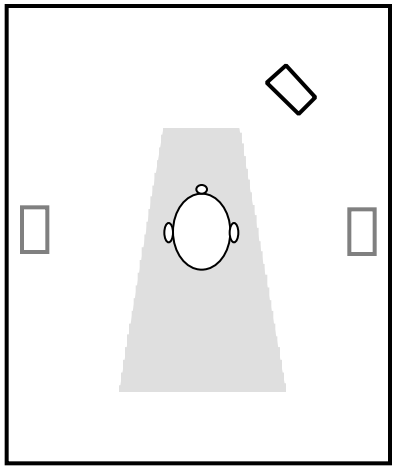


First order correction travels to left ear, where it will be heard unless canceled by an additional correction. When these higher order corrections are supplied, accurate cancellation is possible.

signal that is canceling it are eliminated.

This works extremely well when the room is well damped and the listener's head is correctly positioned. The first order devices described earlier required the listener to sit on the center line between the loudspeakers, and to arrange the angle between the speakers to correspond to the programmed delay. Although the CP-1 provides adjustments to compensate for off-center listening and for varying speaker angles, maintaining a consistent listening position is still important and becomes more so with increasing frequency. With wide speaker angles, a movement of as little as 1 inch can make a perceptible difference. Fortunately, the effect is usually fairly good everywhere within a zone about one foot wide.

To achieve the fullest Panorama effect, your main loudspeakers should have good imaging. The smaller speakers that tend to be used with video systems may have an inherent advantage here but the most important requirement is that the two speakers have identical frequency response and symmetrical dispersion. It is not necessary, or desirable, to turn your listening room into an anechoic chamber but moving the speakers away from the walls can be helpful, as can adding absorption (as provided by carpets, curtains and/or sound-absorbent panels) to reduce the reflectivity of the floor, walls and ceiling.



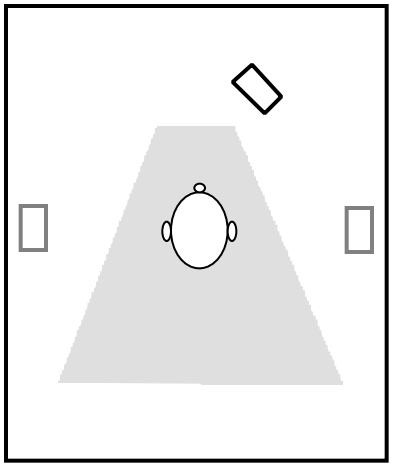
Panorama can be used with music, films, or from within the Reverb and Ambience programs to simulate side speakers if the listener is inside the effective area between loudspeakers.

In a well-damped room with loudspeakers mounted on stands away from the walls, the Panorama effect can be very exciting, giving the closest possible approximation to the actual hall used for the recording. With true binaural recordings (made with a modern dummy head with accurate external ears and proper equalization) the playback can be uncannily realistic. And, unlike previous versions of this technique, the Panorama program adds virtually no coloration to the original signal.

Panorama is used in two ways in the CP-1. First, there are the three Panorama programs, designed to reproduce as closely as possible the sound actually recorded by the engineer. If the recording has good natural ambience, Panorama will spread that ambience around the listener, giving a true impression of the original hall.

The Normal and Wide versions of the Panorama program differ primarily in their handling of low-frequency signals. Normal is designed for recordings whose bass energy is evenly distributed across the stereo stage; Wide is designed for recordings with centered bass. The only other difference between these two programs is in their initial Effect Level. If you need more bass from Panorama Normal, use Wide and reduce the Effect Level. Conversely, if Panorama Wide is too bass-heavy, use Normal and increase the Effect Level.

The Low Frequency Width control provides another important adjustment to the bass in Panorama. This control is a simple implementation of a Spatial Equalizer (a function which Alan Blumlein referred to as a "shuffler"). One of the ways ordinary stereo excites SI is through the out-of-phase low frequency energy in the recording. The Low Frequency Width control allows the amount of out-of-phase bass in a recording to be adjusted. Even when the Effect level of the Panorama control is all the way down, the Low Frequency Width control is active, allowing the user to experiment with this property of sound.



When the front speakers are close together, the Panorama Effect is less precise but more dramatic, and it works over a larger area.

Recording engineers have only recently become aware of Spatial Equalization[3,4] and many older recordings are greatly improved by increasing the low frequency width a little. When the rest of the Panorama program is not used (by turning down the Effect control) just turning LF Width up a bit can make ordinary recordings quite spacious. The user should exercise caution, however, since some recordings (such as those on Telarc) use microphone techniques which already contain sufficient out-of-phase low frequency energy.

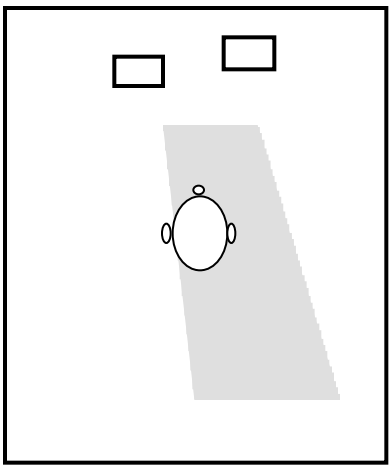
The crosstalk cancellation in Panorama increases the low frequency width as well as the high frequency width of a recording. Recordings in which the engineer deliberately added large amounts of low frequency width will sound too wide and phasey when played with either Panorama Normal or Panorama Wide. Negative values of the Low Frequency Width parameter can bring the low frequencies back in line with the higher frequencies and make the playback with Panorama more effective. The Binaural setting of

Panorama greatly increases low frequency width and should only be used with true binaural recordings, which have very little out-of-phase low frequency energy. A few compatible binaural recordings are becoming available, in which the low frequency width has been increased to match the requirements of loudspeaker playback. These recordings may sound best when played with the Normal setting.

Panorama is capable of simulating side loudspeakers effectively, but cannot mimic sound sources to the rear of the listener. So we have added a simple delayed Left minus Right signal which can be sent to rear loudspeakers. The delay is adjustable, as is the treble rolloff.

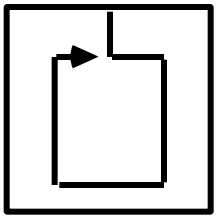
For a listener in the ideal position, Panorama, with one or two rear speakers, gives a nearly ideal re-creation of the original recording area.

Panorama is also used as an element in the Ambience and Reverberation programs, where it can synthesize side loudspeakers which are not present in the installation. In this mode the stereo inputs to the CP-1 are fed directly to the front loudspeakers, with the digital outputs of the CP-1 mixed in according to the setting of the Effect Level control. The Ambience or Reverb side outputs are sent through Panorama before being mixed into the front loudspeakers, so the added sound spreads beyond them and does not interfere with the original material. When side speakers are present, the Panorama Effect parameter is automatically turned down and no mixing occurs into the front speakers.



Speaker alignment is important. A 6" difference in the distance to the rear wall can greatly change the effective area, unless compensated for by the LISTENER POS parameter.

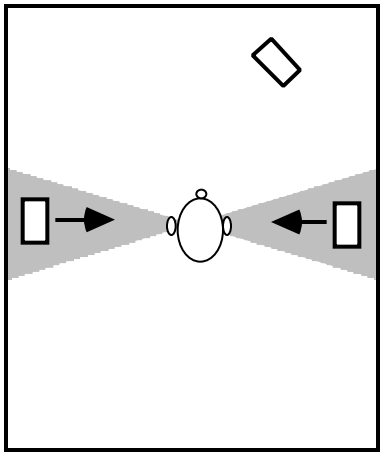
The Ambience Program



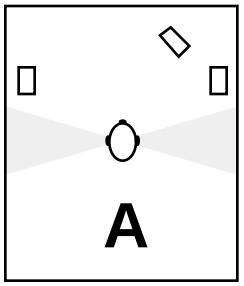
While the Panorama program recreates the space that already exists in the recording, the Ambience program actually generates the side and rear reflection patterns of a number of ideal concert halls. The reflections were determined by computer ray-tracing using architectural data, augmented by Lexicon's 15 years of experience with digital concert-hall simulation.

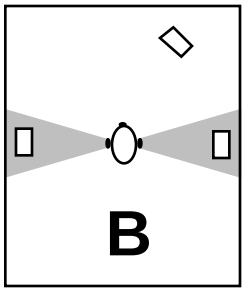
The Ambience simulation is done in stereo. Instead of feeding combined left and right channels to the processor, the CP-1 has two input points corresponding to instruments placed on the left or right side of the stage. From these the computer calculates the loudness and delay of the reflections for the side and rear loudspeakers.

Ambience generates primarily the strong reflections which appear early in the reverberation process (in the first few hundred milliseconds). Although some reverberant decay can be added with the Liveness parameter, the early reflections constitute the primary audible effect, giving you the impression of the hall surrounding you while the music is playing. As in actual concert halls, the most important contribution to spatial realism will



The best way to generate spatial impression (SI) is with appropriate signals from loudspeakers at the side. Reverb, Ambience and the Surround programs can all be used to generate these signals.





Placement of side loudspeakers is critical! Placement B sounds much better than A, especially when the room is well damped.

be the sound that comes from the sides.

Early research with quadraphonics involved extensive experimentation with speaker placement, and confirmed that additional speakers beside the listener sounded better than the conventional approach of putting pairs of speakers in front and behind. Our research into speaker placement with Ambience confirmed the previous results of others: The side speakers should be directly to the side of the main listening position, plus or minus about 20 degrees. Beyond this critical angle the spatial impression is greatly reduced.

The sides are the most important additional speakers, much more so than the rears. Keep in mind that, although you can use the left and right main speakers to simulate a phantom center speaker, you cannot produce SI with one speaker in the front and one at the rear . (You can perform this experiment for yourself with the CP-1 using the Ambience program: Try the side speakers both in their usual positions and in the front corners. If your listening room has enough absorption to damp its side-wall reflections, the side location will provide much more spatial impression, and will sound substantially better.) Speakers in the front are useful - if you want the best possible sound from Ambience you may want to try an additional pair in the front corners, wired in parallel with the rear. This additional pair, as well as the rear speakers, may sound best if placed above the listener.

The effectiveness of the CP-1's Ambience simulation is heavily dependent on the source material and the playback room. If the playback room is large and reverberant, its reflections may dominate those generated by the program. Carpet, drapes and furniture can all be used to break up or absorb undesirable reflections, making it easier to hear the processor's output. The balance between the side, rear and front speakers is also very important. If the channels are set up properly, no single speaker will be audible by itself.

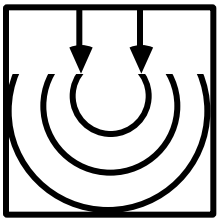
There are two basic hall shapes in Ambience: Rectangular and Fan. In a listening room with sufficient acoustical absorption, using source material without too much reverberation of its own, the two shapes are clearly distinguishable. For most classical recordings the rectangular hall sounds somewhat better because of its stronger side reflections. In our fan-shaped hall (unlike actual physical designs) you can increase the proportion of side to rear sounds, by increasing the Effect Level and shifting the F/B Balance controls toward the front. When this is done, another different but also pleasant sound results.

Although the Ambience program can provide some recirculation (adjustable with the Liveness parameter), for long decay times it is better to use Reverb. The Large Hall ambiences are not intended to be used on material which is more appropriate to a smaller ambience, such as a small hall or a club. Highly percussive material is almost always better in the Small program which is quite successful in livening and expanding popular

music.

If you have no side loudspeakers, both Ambience and Reverb contain versions of the Panorama program that will simulate them within a narrow area between the speakers. Choosing one of the speaker configurations with no side speakers (see page 13) will automatically turn the Panorama Effect on and mix the side outputs into the main outputs. (If you have a set-up with six or more loudspeakers, you may want to try setting the configuration for no side speakers. This will still turn on Panorama and mix the sides to the front, while leaving the side outputs on.)

The Reverb Program

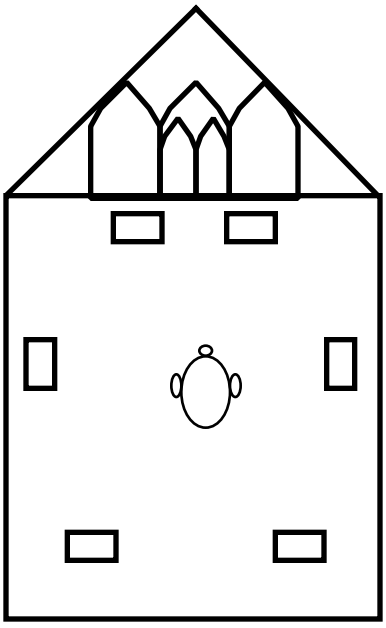


While the Ambience program simulates the early reflections of real halls, Reverberation is more concerned with what happens to the sound after the first hundred milliseconds or so. The first reflections are not intended to simulate any particular hall and no real shape will be audible.

The Reverb program produces a rapidly increasing echo density that smooths out impulsive sounds. The decay in this program is unusually smooth and natural and can create the effect of a church or a very reverberant hall. The early sideways reflections, which produce the most SI, are weaker than they are in the Ambience program. In Reverb, as in Ambience, the stereo input is fed directly to the front loudspeakers. Some of the side energy can also be fed to the front speakers; side and rear outputs are generated from the stereo input.

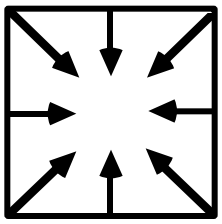
For the largest possible effect from the Reverb programs, consider placing speakers in the front corners of the room and driving them in parallel with the rear speakers. Note, however, that this configuration does not compensate for the absence of side speakers, which continue to be the most important.

Direction is critical to maintaining clarity in Reverb and Ambience. The recording engineer has probably put as much reverberation in the recording as the music can withstand. Adding more through speakers located in front of the listener is generally not a good idea, since these effects combine with the sound from the front speakers, making the music muddy. Delay and reverb in the rear can occasionally be helpful but the ear is not particularly good at distinguishing between front and rear sounds and, as with Ambience, it is at the sides that Reverb is most needed.



Reverb is very good for simulating a large reverberant space.

If you have no side loudspeakers, both Ambience and Reverb contain versions of the Panorama program that will simulate them within a narrow area between the speakers . Choosing one of the speaker configurations with no side speakers (see page 13) will automatically turn the Panorama Effect on and mix the side outputs into the main outputs. (If you have a set-up with six or more loudspeakers, you may want to try setting the configuration for no side speakers. This will still turn on Panorama and mix the



The Surround Programs

sides to the front, while leaving the side outputs on.)

The Surround programs: Mono Logic, Stereo Logic and Pro Logic, are specifically designed for film sound or for systems set up primarily for enhanced film viewing.

Mono Logic

Mono Logic is a stereo conversion program for monaural film sound tracks. A quick look through any video rental selection will prove the usefulness of such a program; the vast majority of titles are mono.

The problem of mono-to-stereo conversion is an old one. One time-honored solution is to break the incoming signal into frequency bands, sending some to one channel and the rest to the other. When the filters are complementary (when the sum of the two output channels equals the original input channel) this solution can give stereo spread without ruining the tonal balance. When the filters are non-complementary, they can produce an unpleasant fake stereo effect.

Some effort has been made to design filter pairs for film sound which leave voice frequencies unchanged while spreading out the music. More recent designs have gone in another direction, using digital or analog delay lines to produce a comb filter effect. So far, these attempts have not been very successful.

The principal element of film sound is dialog and the principal rule in reproducing it is to assure that it appears exclusively in the center channel. Broadcasters, who have an interest in converting mixtures of dialog and music to synthesized stereo, have built circuits designed to turn off the stereo synthesizer when voice appears. Unfortunately, the switch from mono to stereo is often abrupt and the chances of dropping into mono by mistake during music are high. One basic problem with films, especially modern ones, is that music or background effects which should be spread out into the side speakers frequently appear at a low level beneath the dialog.

The Mono Logic program electronically identifies certain properties of film speech and removes it from the stereo synthesis. This allows music and effects in the dialog to be spread out while leaving the dialog centered. The remaining music and effects are directed to the input of a room simulation program that creates a space the size of a large room or small theater. The

room simulator has outputs for left, right, side and rear surround speakers.

The monaural input sound from the film is unchanged in the center speaker, so that all the dialog and music that the director expected to come from the screen still does, with no modification or reverb. Partly because of the acoustical character of the room synthesizer, the result is often so successful that switching from a monaural input with Mono Logic to a stereo input with Pro Logic may make a surprisingly small difference.

During the early days of film stereo, dialog was sometimes mixed (by "panning" the monaural dialog track) to come from the same part of the screen as the image of the actor. Subjective reactions to this technique were varied, and technical problems with some magnetic sound tracks helped to discourage the practice, so modern movies are seldom mixed with panned dialog. In a home system with a good Pro Logic decoder, however, the effect can work quite well; recent releases with panned dialog include "Yellow Submarine" and "Superman I". In most films, though, all dialog comes from the center channel.

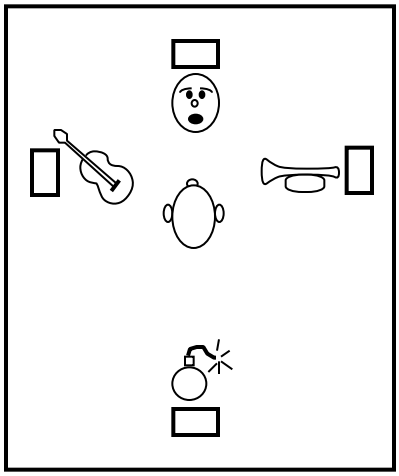
The most critical adjustment in Mono Logic is the Effect Level. Ideally the film's music and effects should appear to come from the front but with the added sense of a large space surrounding you. The side and rear speakers should not be individually audible.

Mono Logic works with the left input channel only. If it is used with a stereo input, material recorded exclusively in the right channel will be ignored.

Pro Logic

The CP-1 is one of a few consumer products to offer full Pro Logic Dolby Surround decoding, and it is the only one that operates entirely in the digital domain. This has important advantages, but to understand them we must first take a brief look at how a film soundtrack is put together.

A Dolby Stereo film sound track has four basic components: Left and right channels, a center front channel and a surround channel. The first three are fed to speakers arrayed behind the movie screen, while the surround sound goes to speakers on the side and rear walls of the theater. The four channels are recorded on separate magnetic tracks and are combined by the Dolby Stereo matrix encoder into two stereo channels during the final mixing process. The original left and right channels go directly onto the left and right channels of the Dolby Stereo mix. The center channel is fed equally to both channels, in phase, and the surround track is fed equally to both channels, but 180 degrees out of phase.

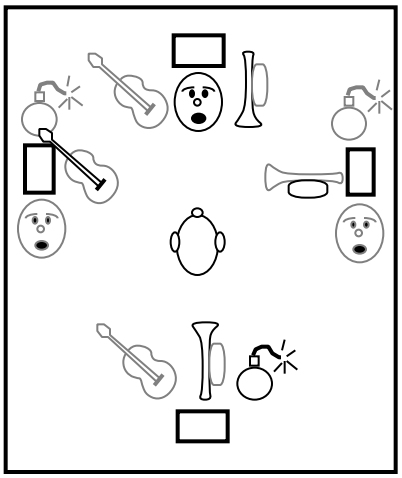


Films originally have four channels: one for dialog and three for music and effects. To make a Dolby Stereo film, these are combined to <u>two</u>.

The center channel carries the dialog; music is normally mixed so that it appears to come from the front, with reverberation or ambience coming from the surrounds. For special effects, music can be encoded to come from all around the listener or even from behind. In any case, with music and ambient effects there is always substantial spread across the front of the loudspeaker array.

Sound effects can come from any direction around the listener and it is the job of the decoder to duplicate as closely as possible the film mixer's

placements.



With conventional surround any sound comes from at least three directions.

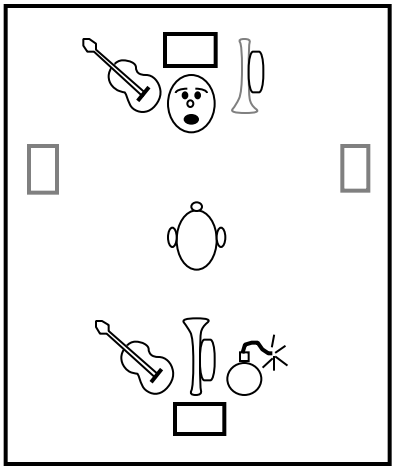
Dolby Surround Decoding

When the movie is shown the two Dolby Stereo tracks must be decoded and separated into the original four. The Dolby Surround decoder does this in a rather rudimentary way: it supplies a signal to the center channel which is just the sum of the two input channels. This signal contains the dialog. However, the left and right signals still contain dialog too, so the dialog is spread out among the three front speakers. Similarly, the Dolby Surround decoder takes all out-of-phase signals and sends them to the surround speakers, while leaving the original out-of-phase components in the left and right front speakers.

The basic Dolby Surround decoder has high channel separation between left and right decoded audio, and between center and surround. The separation between left or right and center, or between left or right and surround, however, is only a few dB. The simple Dolby Surround decoder does pretty well with music (although sometimes the center channel is too loud) but, because any sound will be reproduced in at least three loudspeakers, effects are smeared and often unconvincing .

Pro Logic Decoding

A Pro Logic decoder, like the professional Dolby Stereo cinema processor, both enhances the dialog in the center and removes it from the left and right, while maintaining as much stereo separation as possible. This is a form of directional steering. Properly done, steering prevents the dialog from appearing in the other channels and enhances its plausibility.



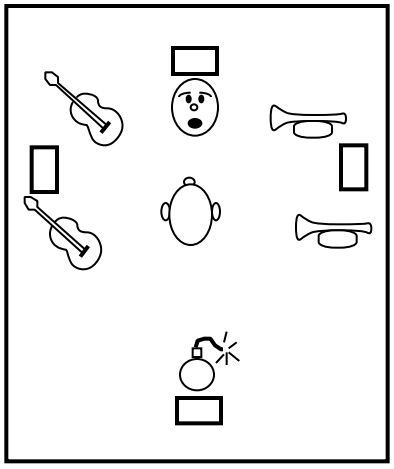
Simple logic decoders turn down the left and right speakers during dialog. This seriously affects music and effects.

The situation is similar with music and sound effects. For example, if the sound was intended to be in the left, the decoder will remove it from the center and surround channels. If it was intended to be halfway between left and center, the Pro Logic decoder presents it equally to the left and center speakers and removes it from the right and surround channels.

The Pro Logic decoder can give good stereo spread and precise control over front-to-back perspective. But the real strength of Pro Logic decoding emerges when music and dialog occur at the same time. When dialog is present, the center channel information must be removed from the left and right channels without reducing the spread or loudness of the music.

Pro Logic decoders sense both the direction of the loudest sound and the difference in level between it and any ambient information. They then use this information to direct the steering. The accuracy with which this is done

is even more important in a home decoder than in a professional model, because the small size of the playback room makes decoding errors more audible than they are in a theater. The level detection must be very fast, and the matrix must adapt very quickly or there will be a time lag between the audibility of a sound and its correct steering. Since phase relationships determine how the sound is steered, Pro Logic decoding puts unusual demands on the accuracy of the phase and balance of the input channels. Other Pro-Logic decoders have a front panel control for adjusting input balance and for best results a user should carefully adjust this for each program. But what if the channel balance varies during playback?



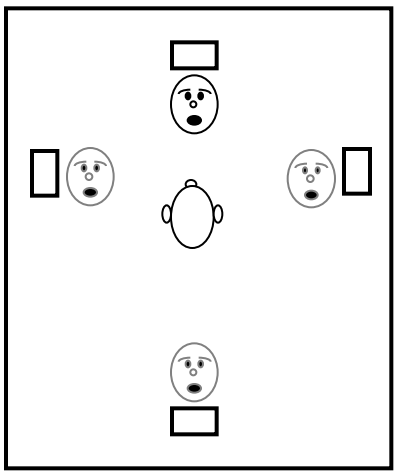
Pro Logic decoders remove dialog from the left and right channels, while maintaining stereo as much as possible.

The manual balancing procedure does nothing to correct azimuth errors. During the preparation of the master for a video tape or disc, misalignment of the playback heads or skewing of the film produce small time differences between the two channels. Azimuth is poorly controlled in both professional video recorders and optical film chains. In the final product, which has been through many generations, it can easily be wrong by 50 microseconds or more, and may vary as the tape or disk is played. At middle and high frequencies it doesn't take much misalignment to generate large inter-channel differences in phase, which are just what the decoder uses to do its steering.

Other Dolby Pro Logic decoders try to deal with this problem by reducing the treble in the surround, so the out-of-phase sibilants in the film do not splatter annoyingly from the rear. This does not, however, reduce the sibilants in the side speakers. Some non-Pro Logic decoders reduce these side-channel sibilants by narrowing the spread of the front channels in the presence of dialog; this compromise is unnecessary in the CP-1.

The CP-1 Decoder

The CP-1 decoder is unusual in a number of ways. First of all, it is entirely digital. (Most surround decoders advertise that they are digital because there is a digital delay line for the surround channel but the matrix and the logic decoding are done in analog.)



Pro Logic requires phase accuracy. Common azimuth errors cause ghost dialog in all channels unless the azimuth error is corrected.

Because the CP-1 is all digital, we can use some of the digital memory to delay all the output channels by 20 milliseconds — about the same as the acoustic delay you get in the front row of a theater. (The surround channel is delayed by an additional 16 to 32 milliseconds.) This delay allows plenty of time for the CP-1 to determine the direction of sounds and adjust the matrix before the sounds are sent to the amplifiers. This substantially improves dialog and effects cancellation, as is immediately apparent from the spread of ambient material or music, even in the presence of dialog.

The CP-1 can also sense and continuously correct both balance and azimuth errors in the incoming material. All the time the film is playing, the CP-1 is checking balance and azimuth, keeping the dialog perfectly centered. The

result is superior steering. An added benefit is that the CP-1 is the only Pro Logic decoder which needs no front panel input balance control; the user need not bother with this adjustment. You can check the quality of the balance and azimuth in a tape or disc if you wish by turning the Auto Azimuth/Balance parameter off and observing any changes in the location of dialog and effects.

In addition, because the side and rear cancellation of dialog is unusually good even with poor material, you can use Stereo Logic to set the rear channel filtering higher than is recommended in the Pro Logic specifications. This added surround brilliance makes some effects, such as falling rain all around you or objects zooming from rear to front, much more convincing. This feature should be used with caution, however, since in this mode the decoder is different from the one on which the film was mixed.

Stereo Logic

The Stereo Logic program is primarily designed for the playback of music through film-sound systems. Its basic structure is similar to Pro Logic but it contains more variable parameters. In the Preset version of Stereo Logic these parameters are set for music but they can be changed to produce a versatile program for film sound as well.

The range of the Rear Delay parameter is 0-32 ms, as opposed to 16-32 ms in Pro Logic, for use with music programs in which you may want to hear the front and rear outputs of the program simultaneously.

Music does not necessarily contain a crucial, centrally located element analogous to the dialog in films. So the Preset version of Stereo Logic has no automatic adjustment for interchannel time delay and balance (that is, the Auto Azimuth/Balance parameter is off). The Front Effect parameter, which controls the steering among the front three channels, is preset half way up, meaning that centrally located sounds are diminished by 6 dB in the side speakers and vice-versa. The setting for Dolby Stereo films is 16 (up all the way).

The Rear Effect parameter controls the steering of effects, music and ambient sounds to the rear speakers. Its preset value is determined by the speaker configuration specified by the user. (See page 13.) The preset value is zero if there are no rear speakers in your system and 8 (of a possible 16) when there are rear speakers. When the Rear Effect is set to zero all rear

sounds appear in the front left and right speakers (and the side left and right speakers, if present).

The Rear Noise Chip parameter is preset to OFF, meaning that the high-frequency sound in the rear channels is set solely by the Rear Rolloff parameter. (The Rear Noise Chip should be ON for Dolby Surround programs.) Rear Rolloff is preset to 14.1 kHz, its highest constant value. An Automatic mode expands to accommodate signals steered to the rear, then shuts down to 7 kHz for lower percussion leakage when there are no signals there. This is a useful feature for films.

The Stereo Logic Program can provide an unusual and revealing way to listen to music. With a multi-speaker surround system the program puts you in the middle of the music, so that interior elements formerly buried in the mix become audible. Try setting Front Effect and Rear Effect all the way up; then mute the center channel by pushing System Mute to turn main and effects signals off, then Effects Mute to turn everything but the center back on. This allows you to hear all of the mix (except for strongly centered

Speaker Set-Ups for Pro Logic

material such as vocals) separated and spread throughout the room. This method also provides an interesting look into the details of film sound mixes.

The requirements for film sound are quite different from those for the playback of music. The most important track in any film is the dialog. When the two stereo channels are played back through two speakers with no decoder, dialog will appear to come more or less from the center, but only for those listeners on the center line of the main stereo pair.

The most important job for a Pro Logic decoder is canceling the dialog from left and right loudspeakers. To be able to hear this you have to set up a center speaker. We strongly recommend that a center channel speaker be used with any surround decoder; the difference it can make to the subjective quality of a film is enormous.

Assuming some form of center speaker has been provided, the next most important point is providing enough spatial impression. Once again, the best way to do this is with loudspeakers at the sides of the listeners. When we tried this with the CP-1 we made an interesting discovery. When the Left and Right loudspeakers are spread wide enough to fall within 20 degrees of the listeners' sides, there is a tremendous change in the impact of the film. The sound stage becomes much wider than the screen - so wide in fact that the listener is literally drawn into the action. This effect should not be surprising - lateral sound is known to grab our attention in a way that front

sound does not. Occasional extra wide sound effects can seem peculiar at first for being so much wider than the screen but when the mix is good the emotional impact of the wide sound can be very great. The disparity between the size of the video screen and the size of the sound is usually easy to accept, and the added impact is hard to give up once you have heard it.

A few theaters are beginning to wake up to the power of this effect. It is being used presently and has been used in the past. Some theaters, such as Imax and Omnimax, use it routinely with multi-track masters, and older techniques such as Todd-AO had wonderful multichannel soundsystems.

The major reason standard theaters do not use this is the poor accuracy of previous surround decoders when used with commercially available stereo prints. Azimuth errors on both optical and magnetic masters are common and in theaters there can often be considerable dialog leakage into the left and right channels. To increase the seating area with acceptable dialog, theaters place the left and right speakers within the confines of the screen.

The needed spatial impression is supplied by the acoustics of the theater itself, augmented by surround speakers placed all around the audience. The surround speakers are driven in parallel from the surround channel output of the decoder.

The CP-1 can be used to create a similar set-up in the home by connecting the side speakers to the rear amplifiers. However, our experiments indicate that most people find this far from optimal. The use of auto azimuth, auto balance and digital steering make the CP-1 superior to any other surround decoder, including the professional decoder for theaters. This allows us to remove the dialog completely and feed the left and right signals (not the surround) to the side speakers. When side speakers are present this is a marvelous solution. (See speaker configurations 10 and 11, page 13.) Much the same effect as separate side loudspeakers can be provided by simply placing the main loudspeakers near the sides of the listeners and using the center loudspeaker to fill in the middle of the front image.

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Frequency Response:	Unprocessed channels:	10 Hz - 100 kHz, +1, -3dB*
	Processed channels:	10 Hz - 16 kHz, +1, -3dB*
	*Ref. 1 kHz	
THD:	Front:	Less than .05%, 1 kHz, max level
	Sides:	Less than .05%, 1 kHz, max level
	Center:	Less than .05%, 1 kHz, max level
	Rears:	Less than .05%, 1 kHz, max level
	Subwoofer:	Less than .05%, 10 - 100 Hz, max level
Minimum Input Level:	300 mVRMS	
Maximum Output Level:	3.5 VRMS	
Input Impedance:	50 k ohms	
Output Impedance:	500 ohms	
Signal to Noise Ratio:	85dB min, A-weighted, Ref. 1 kHz max level	
Voltage:	120V / 60 Hz 100V / 50-60 Hz 220V / 50 Hz 240V / 50 Hz	
Dimensions:	17"W x 12.5"D x 2.5"H	
Weight:	11 lbs.	
Optional Equipment:	Rack-mount adapter, Lexicon Part# 021-06639	

Specifications subject to change without notice.

Patents are pending on the CP-1

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